THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 17 AUGUST, 1938 Number 8

FRANK J. TONE

See page 333 for story of Dr. Tone

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THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY

Volume 17 **August, 1938** **Number 8**

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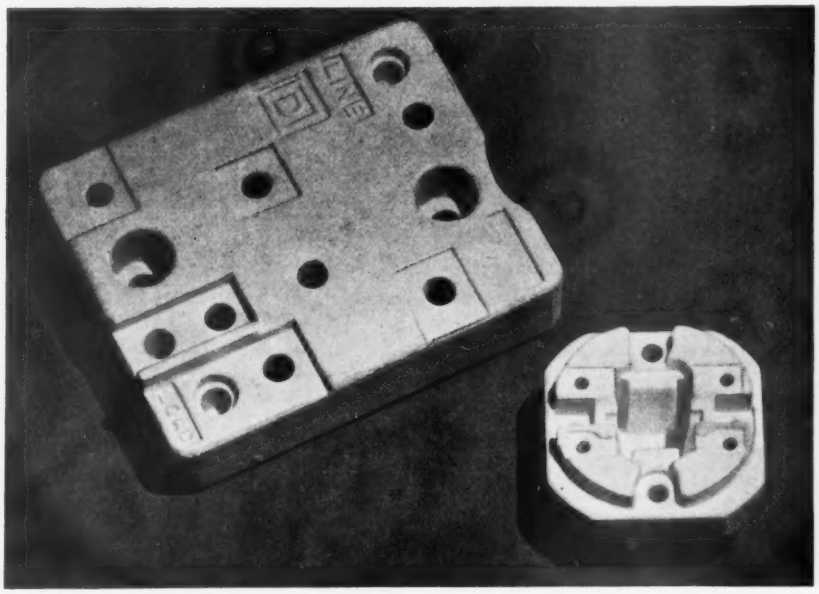

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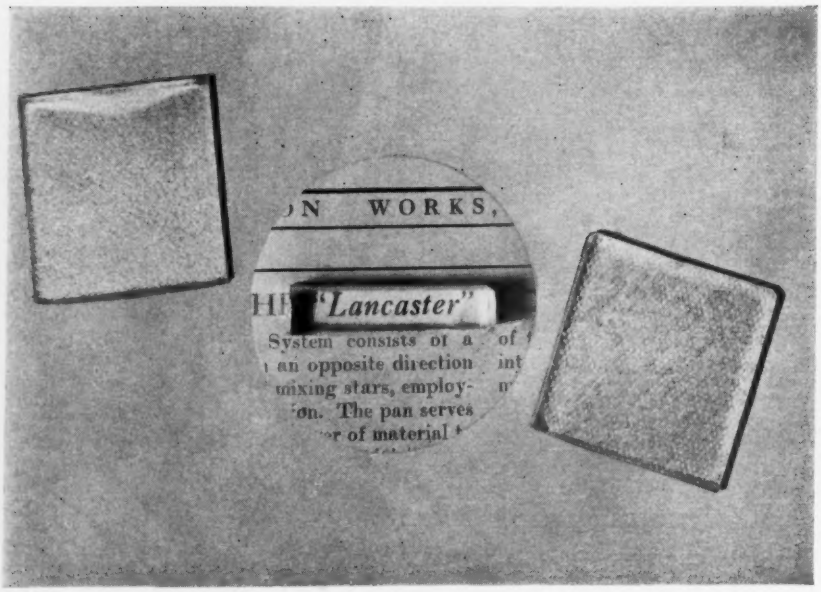

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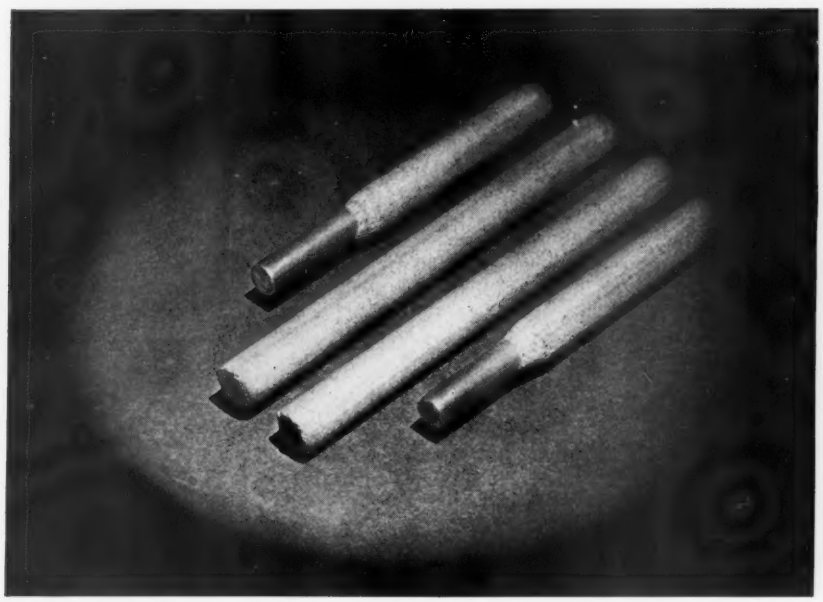

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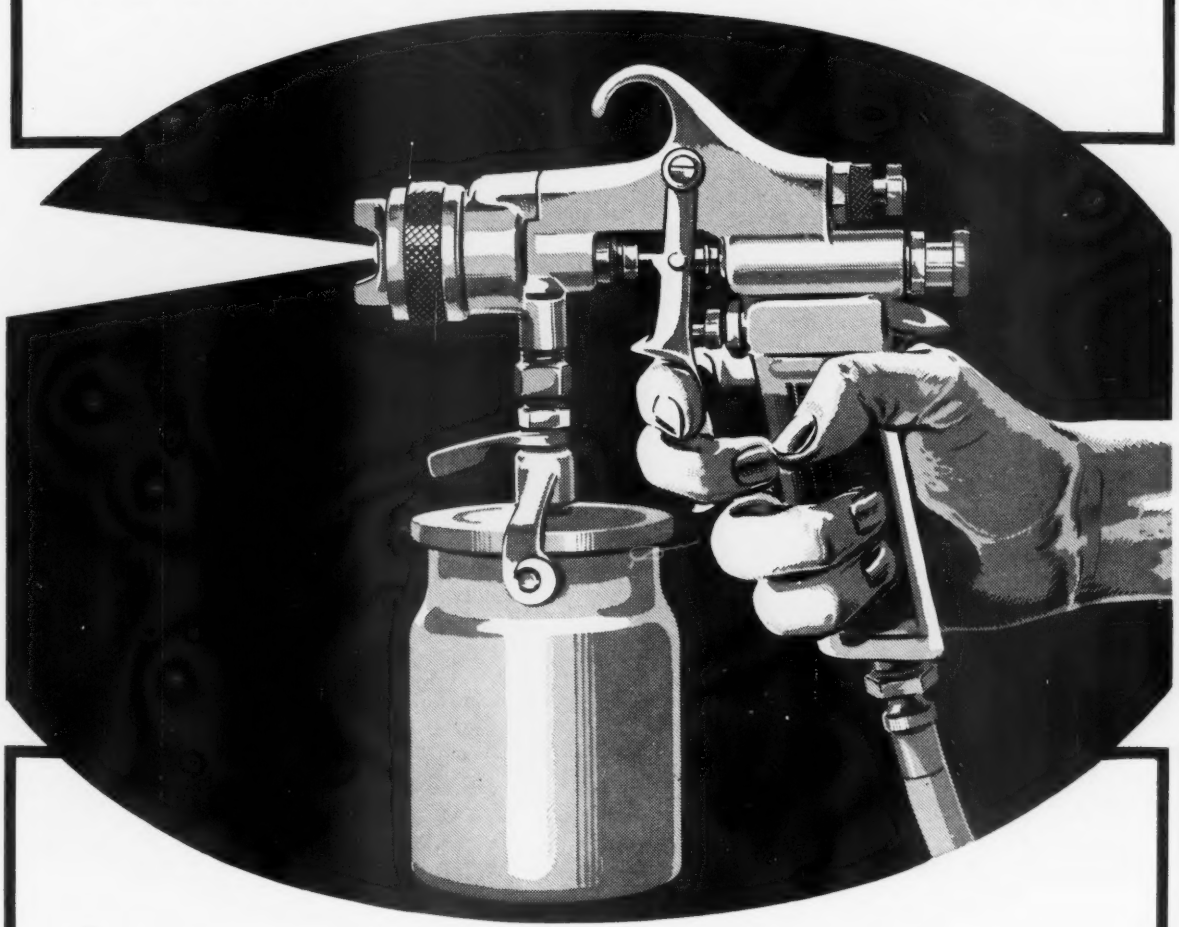

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Lancaster Iron Works, Inc.

Cryolite (see Kryolith)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
The Vitro Mfg. Co.

Crystolon (Refractory Products)
Norton Co.

Cullet, Washing Plants, Incinerators, Crushers
Frazier-Simplex, Inc.

Cutters (Bar)
Ransome Concrete Machinery Co.

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Disintegrators
Hardinge Company, Inc.
Lancaster Iron Works, Inc.

Dryer (Pipe Rack)
Lancaster Iron Works, Inc.

Drying Machinery
Frazier-Simplex, Inc.
Hardinge Company, Inc.
Lancaster Iron Works, Inc.
Proctor & Schwartz, Inc.

Electrocast Refractories
Corhart Refractories Co.

Enameling Equipment (Complete)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Enameling Furnaces
Carborundum Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.
Lancaster Iron Works, Inc.
Norton Co.

Enameling Iron (Sheet)
American Rolling Mill Co.
Bethlehem Steel Co.

Enameling Muffles
Bethlehem Steel Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Norton Co. (*Alundum*)

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Enamel Oxide
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
Hardinge Company, Inc.
The Hommel Co., O., Inc.

Exhaust Systems
The DeVilbiss Co.

Feldspar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Fire Brick
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire Clay
Denver Fire Clay Co.
Spinks, H. C., Clay Co.

Flint
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.

Flint Pebbles
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Floors (Non-Slip)
Norton Co.

Fluorspar
Harshaw Chemical Co.
The Hommel Co., O., Inc.

French Flint
Paper Makers Importing Co.

Frit
Allied Engineering Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Frosting Mixtures
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Fuel Oil Systems and Control, Stokers
Bethlehem Steel Co.
Frazier-Simplex, Inc.

Furnaces
Allied Engineering Co.
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Swindell-Dressler Corp.

Furnaces-Enameling
Swindell-Dressler Corp.

Glass Bending Ovens, Glass Decorating Machines
Frazier-Simplex, Inc.

Glass Equipment
Hartford-Empire Co.
Lancaster Iron Works, Inc.

Glass Melting Tanks and Furnaces
Frazier-Simplex, Inc.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Goggles
Cover, H. S.
The Hommel Co., O., Inc.
Willson Products, Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. H. & Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Granulators
Hardinge Company, Inc.
Lancaster Iron Works, Inc.

Grinding Wheels
Carborundum Co. (*Carborundum and Aloxite*)
Chicago Vitreous Enamel Product Co.
Norton Co. (*Alundum-Crystolon*)

Hearths
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co. (*Crystolon*)

Hearths (Fused Al_2O_3, SiC)
Electro Refractories & Alloys Corp.

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

Hoppers (Floor, Tower)
Ransome Concrete Machinery Co.

Hose (Air and Fluid)
The DeVilbiss Co.

Hydrofluoric Acid
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Iron Chromite
Harshaw Chemical Co.

Iron (Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Kaolin
Ceramic Color & Chemical Mfg. Co'
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
United Clay Mines Corp.
The Vitro Mfg. Co.

Kellog AA Refractories
Electro Refractories & Alloys Corp.

Kilns, China (Decorating)
Allied Engineering Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Swindell-Dressler Corp.

Kilns-(Electric, Circular, Tunnel)
Allied Engineering Co.
Swindell-Dressler Corp.

Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide) (Refractory)
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.

Kyanite
Celo Mines, Inc.

Kryolith (See Cryolite)
Pennsylvania Salt Mfg. Co.

Laboratory Ware
Norton Co.

Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Electro Refractories & Alloys Corp.

Lehrs
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehrs (Electric or Fuel Heated)
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehr Loaders
Frazier-Simplex, Inc.

Linings (Furnace Refractory, Block Refractory Plate, Brick and Tile)
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
The Vitro Mfg. Co.

Lithium Carbonate
Foote Mineral Co.

Lithium Minerals
Foote Mineral Co.

Magnesia (Fused)
Electro Refractories & Alloys Corp.
Norton Co.

Magnesia (Sintered, Calcined)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Magnesite Calcined
Foote-Mineral Co.
The Hommel Co., O., Inc.

Magnesium Carbonate
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Manganese Dioxide
Foote Mineral Co.

Manganese (Oxide)
Ceramic Color & Chemical Mfg. Co.
Corhart Refractories Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Masks (Breathing)
The DeVilbiss Co.
Willson Products, Inc.

Metals (Porcelain Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Microscopes (Polarizing)
Bausch & Lomb Optical Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Mixers
Ransome Concrete Machinery Co.

Mixers (Batch)
Lancaster Iron Works, Inc

Mixers (Concrete, Paving, Road Paving, Plaster, Asphalt, Truck, Mortar, Bituminous)
Ransome Concrete Machinery Co.

Mold Sanders
Lancaster Iron Works, Inc.

Muffles (Furnace)
Allied Engineering Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Norton Co.

Muffles (Laboratory)
Electro Refractories & Alloys Corp.

Mullite (Refractories)
Electro Refractories & Alloys Corp.

Muriatic Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Needle Antimony
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Nickel Salts
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Nitre
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Non-Gro Refractories
Electro Refractories & Alloys Corp.

Norbide (Norton Boron Carbide)
Norton Co.

Olivine
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Opacifiers
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Overglaze Colors
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Oxides
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Palladium Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Pins
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Louthan Mfg. Co.
Potters Supply Co.

Pins (Tile Setter)
Louthan Mfg. Co.

Placers (Concrete Pneumatic)
Ransome Concrete Machinery Co.

Platinum Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Polariscopes
Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.

Porcelain Enameling Service (Practical)
American Rolling Mill Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Company, Inc.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Potters Wheels
Denver Fire Clay Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.

The Hommel Co., O., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.

Producer Glass Plants
Frazier-Simplex, Inc.

Pug Mills
Lancaster Iron Works, Inc.

Pyrites (Natural Iron Sulphide)
Foote Mineral Co.
The Hommel Co., O., Inc.

Pyrometer Tubes
Carborundum Co.
Electro Refractories & Alloys Corp.
Montgomery Porcelain Products Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Norton Co.

Pyrometers (Optical, Radiation, Surface, Immersion, Needle)
Pyrometer Instrument Co.

Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation

Racks, Firing (Refractory)
Louthan Mfg. Co.

Raw Material Handling Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.

Refractometers
Bausch & Lomb Optical Co.

Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.
Norton Co.

Refractory Materials
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.
Norton Co.
Titanium Alloy Mfg. Co.

Represses (Automatic)
Lancaster Iron Works, Inc.

Respirators
Chicago Vitreous Enamel Product Co.
Cover, H. S.
The DeVilbiss Co.
The Hommel Co., O., Inc.
Willson Products, Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.
Potters Supply Co.

Salt Cake
American Potash & Chemical Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Sandblast Helmets
Willson Products, Inc.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel Co., O., Inc.

Selenite of Sodium
Drakenfeld, B. F., & Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Setters (Tableware)
Louthan Mfg. Co.

Sheaves (Tower)
Ransome Concrete Machinery Co.

Sheets (Enameling Iron)
American Rolling Mill Co.
Bethlehem Steel Co.

Silica (Fused)
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Harshaw Chemical Co.

Silicon Carbide
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite Refractories
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.

Slabs (Furnace)
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Sodium Fluoride
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Sodium Metasilicate
Harshaw Chemical Co.

Sodium Nitrite
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Silica Fluoride
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Uranate
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Soot Blowers
Frazier-Simplex, Inc.

Special Machines
Frazier-Simplex, Inc.

Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Spray Booths
The DeVilbiss Co.
The Hommel Co., O., Inc.

Spraying Equipment
The DeVilbiss Co.
The Hommel Co., O., Inc.

Spurs
Louthan Mfg. Co.
Potters Supply Co.

Stacks
Lancaster Iron Works, Inc.

Steel Plate Construction
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Stilts
The Hommel Co., O., Inc.
Louthan Mfg. Co.
Potters Supply Co.

Sulfuric Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Talc
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Tanks
Frazier-Simplex, Inc.

Tank Blocks
Corhart Refractories Co.

Tanks (Pickle)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Tanks for Raw Material Steel or Concrete
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Tile (Floor)
Norton Co.

Tile (Muffle)
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Tile Setter Pins
Louthan Mfg. Co.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.

Tile (Wall)
Denver Fire Clay Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Towers (Concrete, Concrete Elevating, Steel Elevating)
Ransome Concrete Machinery Co.

Tri Sodium Phosphate
Harshaw Chemical Co.

Trucks
Lancaster Iron Works, Inc.

Tubes (Insulating)
Carborundum Co.
Louthan Mfg. Co.
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
Carborundum Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
McDanel Refractory Porcelain Co.
Norton Co.

Uranium Oxide
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Uranium Oxide (Yellow-Orange-Black)
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Water Softening Plants
Frazier-Simplex, Inc.

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Whiting
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Winding Drums
Lancaster Iron Works, Inc.

Zinc Oxide
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Zircon
Foote Mineral Co.
The Hommel Co., O., Inc.

Zirconia
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Zirconium Oxide
Foote Mineral Co.
The Hommel Co., O., Inc.

Zirkite (Natural ZrO_2)
Foote Mineral Co.

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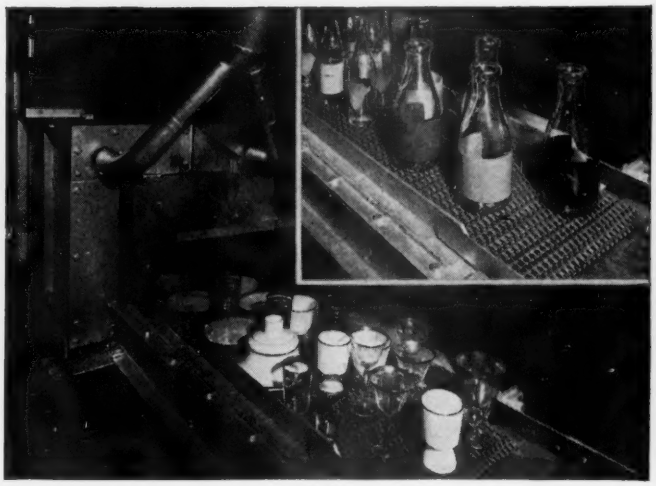

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PAPERS

EFFECT OF FLUXES ON CUPOLA LININGS*

By C. K. Donoho and J. T. MacKenzie

Abstract

The mechanism and types of attack of cupola linings with particular reference to chemical attack and factors affecting the composition of slags are reviewed briefly. Methods of testing refractories for cupola service are outlined, and refractories found to be satisfactory for severe service as well as suitable lining procedures are discussed. Operating conditions and fluidity of slags are revealed as major factors determining degree of attack.

I. Introduction

It has been estimated[1] that the cupola furnace is responsible for the consumption of 3 to 4% of all refractory materials consumed in the United States. Because this amount represents a large volume of fire brick, special shapes, and silica stone, considerable study of the importance of the various factors determining the life of cupola linings is warranted.

Cupola linings are simultaneously subjected to three types of destructive influences[2]: (*1*) *Physical:* Maximum temperatures in the cupola melting zone are generally estimated as slightly over 3000°F, which is often sufficient to cause softening or actual melting of refractories. Temperature changes are sharp enough to cause a certain amount of spalling. (*2*) *Mechanical:* Linings are subjected to wear and abrasion by the descent of the solid charges of iron and coke and by the impingement of solid particles carried upward by the blast. (*3*) *Chemical:* Various constituents of the charges and combustion products react chemically with the lining, causing solution of the refractories or at least softening and lowering of melting points so that the physical and mechanical attack is augmented.

That section of the cupola lining which extends from the tuyères upward two or three feet constitutes the melting zone. It is this area only which is subject to severe attack by all three types of influences. The hearth, below the tuyères, must withstand the temperature of molten iron and some chemical action. The stack, above the melting zone, must withstand severe abrasion but no extreme heat or chemical action. Therefore it is only in the melting zone that the lining must be partially renewed or patched after each heat. A new cupola is usually lined for the first heat with standard cupola blocks from the bottom of the hearth to just above the charging door, with, of course, openings for tuyères, tap hole, and slag hole. After each subsequent heat, the melting zone only is patched to the original dimension of the lining inasmuch as the rest of the lining lasts indefinitely.

In standard practice at the writers' plant, for patching the melting zone of the cupolas after each heat, frozen slag, coke, and iron, adhering

* Presented at the Fortieth Annual Meeting, American Ceramic Society, New Orleans, La., March 31, 1938 (Refractories Division). Received March 5, 1938.

[1] J. D. Sullivan, "Notes on Some Foundry Refractories," *Trans. Amer. Foundrymen's Assn.*, **44**, 255 (1932).

[2] J. T. MacKenzie, "Effect of Variations in Cupola Practice on the Life of the Refractory Blocks," *Jour. Amer. Ceram. Soc.*, **8** [11] 720–33 (1925).

to the walls around the tuyères and above, are chipped out until a clean firebrick surface is exposed. Nine-inch straight and split fire brick are carefully laid in as required, using a thin slurry behind the brick and in the joints. The fire brick used are so-called "overburned" brick made by the stiff-mud repress process, and the slurry is composed of one part finely ground firebrick grog to one part plastic fire clay, mixed with water. A local fire clay found to be satisfactory contains about 90% silica. This clay is sufficiently refractory and is also surprisingly plastic for a clay of this composition.

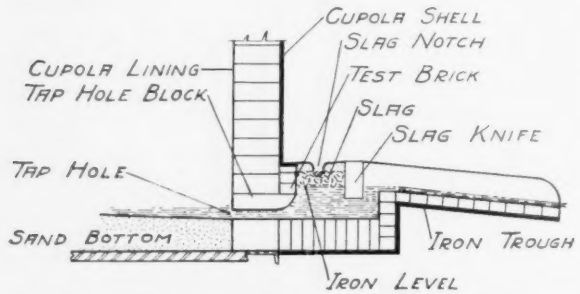

FIG. 1.—Comparative test for rating fire brick.

The patching approximately restores the straight line of the cupola shaft but is not allowed to encroach on the cupola area. The damp patching is dried slowly by a wood fire before blowing in.

In selecting fire brick for melting-zone service, three principal properties must be considered: density, toughness, and spalling resistance. A refractory which possesses one of these to an extreme degree will probably not be the most successful, but the cupola brick must possess all these properties in the correct proportion or "strike a happy medium." In considering density, it is well to qualify this property. In a dense fire brick, the apparent porosity, or percentage of open pores, usually runs low. This low porosity is important, but it is also essential that the pores be small and that the brick possess a low permeability. The size of the pores is particularly important in determining the degree of chemical attack by slags.

II. Testing Refractories for Cupola Service

A simple comparative test has proved effective for roughly rating the suitability of refractory material for melting-zone service in the cupola (see Fig. 1 and Table I). A 9-inch straight brick of the material to be tested is placed just above the taphole of a 72- by 102-inch link-shaped cupola used in production. These cupolas normally run for 8 hours under fairly uniform conditions with an output of 20 to 30 tons per hour. The molten metal and slag flow continuously from the tap hole and pass over the exposed surface of the test brick for the complete 8-hour run. In this test, the brick is subjected to approximately the same physical and chemical attack which would be encountered in service although the mechanical attack is negligible. The depth of cutting the brick is measured and compared with standard brick having known service qualifications. Samples of fire brick of unknown service properties are always tested in this manner before attempting to use them in the cupola lining. So far, in every case where the brick tested stood up as well as standard brick, these brick have given satisfactory melting zone service.

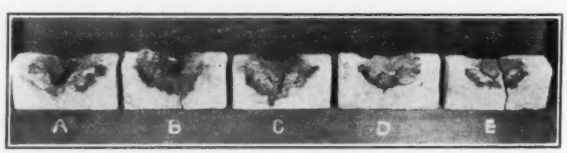

FIG. 2.—Typical fire brick subjected to comparative test.

TABLE I

DATA ON FIRE BRICK SUBJECTED TO COMPARATIVE TEST

	A	B	C	D	E
SiO_2	56.00	60.00	60.00	63.5	64.5
Al_2O_3	38.29	34.10	31.96	29.1	27.0
Fe_2O_3	1.85	1.70	2.81	2.8	2.8
TiO_2	1.70	1.58	1.49	1.6	1.4
MgO and CaO	0.68	0.80	0.98	1.1	1.10
Alkalis	1.39	1.40	1.93	1.9	2.98
Fusion point (P.C.E.)	33	32–32½	31	30–31	29
" " (°F)	3128	3092–3131	3056	3002–3056	2984
Modulus of rupture (lb./sq. in.)	1127	1700	1857	2100	2150
Absorption (%)	14.20	10.80	8.70	5.8	2.9
Apparent porosity	28.2	21.5	15.9	12.7	5.6
Dry weight	7.25	7.50	7.50	7.7	7.7
Water-dip spalling for 20% loss	27+	15	10	9.10	5

Figure 2 shows typical fire brick which have been subjected to this test. It is apparent that attack by this test decreases as the porosity decreases. Fire brick E showed the least attack; fire brick D is the brick which was used as standard during the subsequent tests because it was less costly than brick E and also is less likely to be subject to attack by spalling.

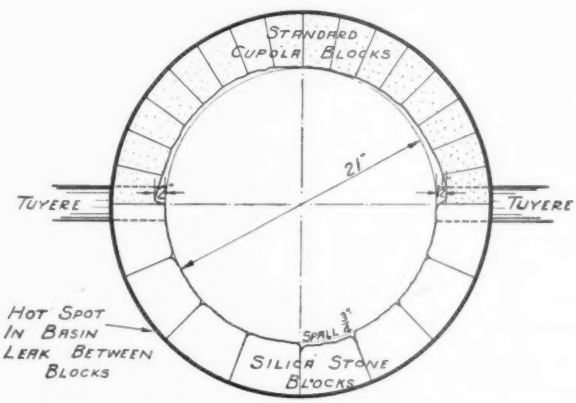

FIG. 3.—Comparison of silica stone blocks with standard cupola blocks. Cross-section 12 inches above tuyères. *Twelve charges* (*lb.*): 12½ coke, 4 dolomite, 100 electric furnace pig. *Three charges* (*lb.*): 10 coke, 4 dolomite, 100 rusty steel scrap, 50 pipe scrap.

A more thorough test for lining materials of unknown properties by use of a small test cupola has been discussed.[3] Figure 3, which is self-explanatory, shows a recent test of this type, using blocks cut from a natural silica rock and standard fireclay blocks.

III. Effect of Fluxes—Service Tests

(1) Test Series No. 1

Standard cupola practice at this plant involves the use of locally obtained dolomite as a flux. This is added with the coke in the charge to the amount of approximately 3% of the metal charge, coke being about 10% of the metal charge. By this practice, a slag of good fluidity is produced which has no severe cutting action on refractories.

During the past year, the supply of dolomite was shut off for a short period and limestone was tried as a substitute. Analyses of the two fluxing materials and slags resulting are given in Table II.

The limestone slag seemed less fluid than the dolomite slag and often appeared foamy, sometimes causing trouble by rising up in the cupola until the tuyères were partially blocked. The cupola lining, which was of the standard fire brick previously described, was more severely attacked when limestone was used as the flux, as the data in Table III will show.

[3] J. T. MacKenzie, "Use of a Small Cupola in Testing Cupola Linings," *Jour. Amer. Ceram. Soc.*, **12** [7] 443–46 (1929).

TABLE II

ANALYSES OF TWO FLUXES AND RESULTING CUPOLA SLAGS

	Limestone	Dolomite	Limestone slag	Dolomite slag
CaO	50.80	30.95	24.35	15.04
MgO	1.17	20.55	0.95	11.60
SiO_2	2.60	1.32	45.88	47.05
Iron Oxide	0.66	0.39	6.80	3.15
R_2O_3	0.80	0.33	*22.02	*23.16
Loss on Ignition	43.97	46.46		

* Largely Al_2O_3.

TABLE III

EFFECT OF FLUX USED ON REFRACTORIES CONSUMED (72- BY 102-INCH CUPOLAS)

		Flux: Limestone	Flux: Dolomite
Total number of heats		20	20
No. of heats requiring	150–200 9-in. equivalents		2
	200–250 " "		10
	250–300 " "	5	6
	300–350 " "	7	2
	350–400 " "	4	
	400–450 " "	1	
	450–500 " "	2	
	Over 500	1	
Av. No. 9-in. equivalents required per heat		345	220

The number of brick used to patch the lining to the original dimensions after each heat were recorded and are here expressed as 9-inch equivalents, which is the sum of the number of 9-inch straights and one-half the number of 9-inch splits required. Table III gives the data for the 72- by 102-inch link-shaped cupolas which were melting approximately 25 tons per hour for an eight-hour shift. There was little difference in the mixes charged, coke ratios, blast pressures, etc., from one heat to another during this period, so the difference in amount of patching as shown in Table III may be reasonably attributed to the flux used.

(2) Test Series No. 2

During the same period, records were kept on patching 60-inch diameter cupolas melting approximately 11 tons per hour for a 16-hour heat. Owing to the length of the heat, lining attack was more severe and there was difficulty in making the linings last for the entire heat. In order to increase the fluidity of the slag while dolomite flux

was not available, some heats were run using 15% fluorspar mixed with the limestone as a flux. Results are shown in Table IV.

TABLE IV

EFFECT OF FLUX USED ON REFRACTORIES CONSUMED (60-INCH CUPOLAS)

		Flux		
		Limestone	Limestone and 15% CaF_2	Dolomite
Total number of heats		14	12	8
No. of heats requiring	400–500 9-in. equivalents	9	8	8
	500–600 " "	2	4	
	600–700 " "	1		
	Over 700	2		
Av. No. of 9-in. equivalents required per heat		522	483	442

Observations less quantitatively mensurable than brick consumption show even more definitely the relative attack when using these three fluxes. When limestone alone was the flux used, about one-half of the heats showed lining attack such that the cupola shell became red hot over the areas of most severe attack. In the two cases where more than 700 nine-inch equivalents were consumed, the shell was melted through before the heat was completed. When fluorspar was used with the limestone, "hot spots" showed up in only two heats. During the eight heats when dolomite was used there was no lining trouble whatsoever.

TABLE V

EFFECT OF FLUX USED ON REFRACTORIES CONSUMED (42-INCH CUPOLAS)

Heat No.	Flux used	Refractories consumed (9-in. equivalents)		
1	Dolomite	188		
2	"	168	av.	180
3	"	185		
4	Dolomite + 5% Purite	120		
5	" "	125	av.	121
6	" "	118		
7	Dolomite + 10% Purite	178		178

(3) Test Series No. 3

A pair of 42-inch cupolas, running alternate 8-hour heats at practically their maximum capacity of 7 tons per hour, were selected as the instruments for testing the action of sodium carbonate or Purite on cupola linings. The metal charges were composed of pig iron plus 40% steel scrap. This high percentage of steel as well as the high melting rate caused the attack of linings to be unusually severe because the steel scrap is more easily oxidized than the pig iron containing higher percentage of carbon and silicon.

Table V shows a record of seven consecutive heats with three fluxes.

"Hot spots" on the cupolas occurred in two of the three heats using dolomite alone as a flux and in the heat using 10% of Purite with the dolomite, while there was no lining trouble when 5% of Purite was used. The slag analyses showed 9% of iron oxide in the slag from heat No. 2 and only 6% iron oxide in the slag from heat No. 5.

IV. Discussion of Results

Numerous investigators[4] have referred to the violent attack of cupola refractories by iron oxide in the melting zone. Any factor of cupola operation which causes undue oxidation of the metal would be expected to increase the attack of the lining.

A viscous, high-melting slag is one factor which often contributes to excessive metal oxidation. Such a slag is easily solidified by the air blast from the tuyères, causing "bridging" in or below the melting zone. Air passages are restricted with consequent formation of local high-velocity jets of air which may violently oxidize the melting metal or may even act directly against the hot lining. Viscous slag is also more likely to contain localized concentrations of corrosive constituents which in a free-flowing slag would be diluted by more thorough mixing.

Stiffness of the slag may therefore increase the attack of cupola linings (1) by causing an increase in iron-oxide content of the slag, (2) by deflecting the air blast directly against the lining, and (3) by preventing mixing of the slag and dilution of corrosive constituents.

Test series No. 1 indicates definitely that some magnesia in a limestone-type cupola flux is distinctly beneficial to the life of the refractory lining. Observations indicate that this effect is due to increased fluidity of the slag.

Test series No. 2 shows that fluorspar, although itself corrosive to refractories, may be used to increase lining life by mixing with limestone to increase the fluidity of the slag.

Test series No. 3 shows how sodium carbonate,

[4] A. H. Kuechler, "Influence of Fe_2O_3 and TiO_2 on Pure Clays," *Jour. Amer. Ceram. Soc.*, **9** [2] 105–106 (1926).

as claimed by Evans,[5] may be used as a small percentage of the flux to decrease attack of the lining. That a higher percentage of sodium carbonate may cause appreciable chemical attack of the lining is evidenced by the last heat shown.

These results indicate that deleterious chemical action of fluxes themselves on cupola linings may be exaggerated and that fluidity of slag at operating temperatures is an item of primary importance. Users of refractories for cupola linings should carefully investigate operating conditions before condemning a refractory for melting zone service.

[5] G. S. Evans, "Sodium Carbonate Compounds Affect Refractory Linings," *Foundry*, **55**, 632–34 (1927); *Ceram. Abs.*, **6** [11] 522 (1927).

American Cast Iron Pipe Company
Birmingham, Alabama

Discussions

C. E. Bales, Ironton Fire Brick Co., Ironton, Ohio[1]: The authors have developed an interesting comparative test for determining the suitability of fire brick for melting-zone service. The test apparently rates the brick correctly from the standpoint of slag erosion and heat resistance, but omits the highly important item of abrasion of the soft, hot brick lining by incandescent coke and the item of spalling caused by spraying cold water on the lining when the bottom is dropped. Even though brick E showed up best in the test, it is doubtful if it would give good life in the cupola. The flux content is high, the P.C.E. low, and it is so dense that it would no doubt show a high spalling loss. In my experience, a block with the properties of brick D should give the best all-around service.

A mixture of lime and magnesia (in dolomite) will form a slag with silica and iron oxide at a lower temperature than lime alone (as in limestone), and conversely a dolomite slag will be more fluid at high temperatures than a straight limestone slag. The thin slag can get out of the cupola more quickly, it does not have a tendency to form bridges, and it does less damage to the cupola lining than the more viscous limestone slags.

It would have been interesting if the authors had done more work on silica firestone in the small cupola. Figure 3 seems to show that the clay blocks cut back more than the firestone, but the stone evidently spalled quite a bit, a hot spot developed, and the metal leaked between the blocks, due no doubt to the high expansion of the stone.

L. C. Hewitt, Laclede-Christy Clay Products Co., St. Louis, Mo.[2]: Simulative service tests are always desirable in rating refractories, and the test developed here would seem to be of aid in the difficult problem of rating cupola refractories. The factors of abrasion and spalling should be covered in some way were the test to be adopted for general cupola practice. The authors state that, for their particular practice (25 to 30 tons per hour for a period of 8 hours), brick rated according to the test have given satisfactory service in the melting zone. A re-rating might be necessary in cupolas operating only a few hours a day. Foundries, operating at different rates, should check these findings.

The authors bring out an important factor affecting cupola refractory service, *viz.*, the type of slag formed causing iron oxide formation. This seems to be a case wherein a more fluid slag actually helps the refractory by preventing the formation of a more corrosive element, iron oxide.

The authors also emphasize the type of laying mixtures to be used in patching, a point apparently overlooked by many foundries.

S. M. Phelps, Mellon Institute, Pittsburgh, Pa.[3]: The authors are to be congratulated for conducting a practical series of tests to discover the effects of factors governing the life of refractories in cupola operation. Such studies by the consumer are not only valuable to them but are also a great help to manufacturers of refractories and those engaged in developmental work.

The most worth-while tests were those resulting from averaging a considerable number of heats in the large-sized cupolas. Attempting to judge the probable behavior of various types of clay refractories in service by placing test brick above the tap hole or from the results obtained in the small-sized cupola at times may prove misleading. It is often impossible to include all of the variables or factors affecting service in a small-scale simulative test, so that in general the final answer must be obtained from actual service trials.

It would be helpful to know the order of importance of the silica content as compared with the density of the series of clay brick A to E with respect to their resistance to slag action. To separate these properties for study, it would probably be necessary to have special brick made up, varying only in one or the other of these two properties.

Offhand, it would seem to be more economical to use dolomite rather than limestone as a flux because of the better life of the refractories and the lower cost of maintenance. Such a matter can easily be decided upon by plant operators, but the question is how many plants have secured the necessary data to be able to do so.

The study is a good example of the benefits which consumers may derive as a result of a practical study of the conditions which affect the life of refractories in their service.

[1] Received April 19, 1938.
[2] Received May 14, 1938.
[3] Received May 16, 1938.

A SANDSTONE-COVERED MISSOURI FLINT CLAY PIT*

By W. D. Keller

The typical Missouri flint clay deposit, as commonly worked, is an open-to-surface, funnel, or irregular-shaped depression containing varying amounts of usable flint clay and usually surrounded by inferior plastic, irony, or sandy clay, which, in turn, is bordered by sandstone. Although none of these worked deposits was previously found to be covered by solid rock, geologists insisted that sooner or later clay extraction would reveal a pit with a solid rock roof. Such a pit has been found and worked near Warrenton, Missouri.[1]

The presence of a roof over a clay pit, while interesting as a curiosity among the many without it, has a greater significance than being merely an exception to the local clay prospector's rule. It gives positive support to the future discoveries of additional flint clay deposits. It also indicates that Missouri's flint clay reserves are larger than is evident at the surface and that new means of prospecting must be employed to find the covered pits.

The clay pit to be described is located about five and one-half miles south of Warrenton, Missouri, along Highway Missouri 47, on the farm owned by August Smith; it lies about 100 yards west of the highway. A clay haulers' road winds down to the pit, which, except for the cover, does not differ from the usual large Missouri flint clay pits north of the Missouri River.

The country rock of the region is a fine-grained, dark gray, somewhat fossiliferous limestone, probably the Chouteau (Mississippian) limestone. A heavy mantle of angular, leached, and oxidized Mississippian chert fragments covers the hillsides. Within this geologic setting, a depression, probably largely the result of solution, was developed for filling during early Pennsylvanian sedimentation. There is little doubt that the flint clay pits are essentially contemporaneous with the plastic clay of the central Missouri district and the Cheltenham clay of St. Louis County.

After the depression was filled with clay material, sand was deposited over the slightly undulating upper surface of the clay to form a thick, massive, gray-to-light-tan sandstone, which extended beyond the pit area.

Other rocks, no doubt, were deposited above and subsequently eroded, but four to six feet of sandstone remain, essentially in one layer. Glacial and colluvial material covers the sandstone.

A microscopic study of the sandstone shows it to be made up of medium-sized quartz grains, which are subangular because of regeneration. It is fairly well but non-uniformly cemented, with silica as the main cement and clay and iron oxide as a subordinate bond. Its porosity seems to be rather high.

The lower six inches of the sandstone grades down into a sandy clay. This, however, is well set off by a parting from about three to six inches of soft, more or less plastic clay beneath. The soft clay layer, in turn, is set off from the typical hard flint clay of the deposit beneath.

Thin sections of the flint clay show it to be a fine-grained mixture of halloysite and kaolinite typical for flint clay, except that it may be higher than the average in kaolinite. The soft clay layer (rejected for refractory uses) is chiefly a highly birefringent clay mineral like montmorillonite or illite and abundant fine-grained, angular to subangular quartz.

The clay pit (abandoned the last season) is roughly elliptical in shape with diameters of about 100 and 125 feet. Clay has been taken out to a depth ranging from 15 to 30 feet and averaging 18 feet. It was mined by Irvin Bethel of New Florence, Mo.

A geological study of the producing flint clay pits in Missouri shows that they have been worked in a region laid bare by erosion advanced to the stage at which there has been removal of the cover but not the clay. This erosion may have been caused in part by pre-glacial streams, by the action of the ice itself, by post-glacial streams, or by a combination of all. The cover may be post-clay age indurated rocks, unconsolidated glacial débris, or later weathered material. Some of the small clay pits, no doubt, are bottom remnants of larger ones which have been weathered and largely carried away.

The physiographic zone most favorable for clay production has been the "break" between the relatively flat upland (Pennsylvanian and glacial surface) and the deeply cut, headward-eroding valleys working back from the Missouri River. Behind (riverward of) this zone, the clay has been removed; ahead of it will lie the "covered" pits. Search for covered pits will probably be made by core drilling or geophysical means instead of present methods of hunting for clay outcrops or float.

Within about a mile southeast of this pit, a small amount of diaspore clay was found. Some of it, analyzed by the Missouri Geological Survey,[2] was found to contain 77.57% Al_2O_3. The occurrence of diaspore clay north of the Missouri River is not common.

Acknowledgment

The writer is indebted to E. C. Noble, Noble Clay Co., New Florence, Mo., for a first visit to the flint clay pit in 1936 and for various data on the pit.

Associate Professor of Geology
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* Received April 29, 1938.

[1] Since this paper was written, H. S. McQueen, Assistant State Geologist, has advised that another "rock-covered" flint clay pit occurs two miles north of Hofflin, Mo.

[2] Personal communication from H. S. McQueen.

DISTRIBUTION OF VOLCANIC ASH*

By Kenneth K. Landes

I. Introduction

Volcanic ash is the finest ejectmenta from a volcano. Most ash consists predominantly of natural glass particles with a subordinate amount of finely divided crystalline material, mainly feldspar and quartz.

Volcanic ash is also known as volcanic dust and pumicite, the latter term being favored over all others by the U. S. Bureau of Mines. Other names which are or have been applied to volcanic ash are geyserite, silica, feldspar, and spar. These terms are all misnomers, but some, especially silica, are used locally.

The word "pumice" is properly applied to larger, highly cellular, glassy ejectmenta. Chemically, pumice and volcanic ash are similar, and ground pumice can be used for the same purposes as volcanic ash. Volcanic tuff is an accumulation of granular material ejected from a volcano. In most instances it has been cemented into rock. If the volcanic material in a tuff is highly siliceous, pulverization will produce a material, similar in many respects to volcanic ash, which can be used for some of the same purposes. Tufa has been used as a synonym of tuff, but it is more properly applied to hot-spring deposits. Trass is a volcanic tuff which is quarried along the Rhine in Germany for use as an ingredient of cement.

II. Age and Origin

Volcanoes were active during many past geologic periods, and the records of such activity in the form of lava flows, tuff, and volcanic ash, or its decomposition products, are to be found in the rocks of all ages. Most of the volcanic ash in the Cretaceous and older rocks, however, has been altered to bentonite and no longer has the same properties and uses. Ash occurs in strata laid down during various epochs of the Tertiary; it is locally abundant in Pleistocene deposits; and it is found as a Recent deposit in the vicinity of active volcanoes, such as Katmai in Alaska. Most of the ash being marketed today comes from Pleistocene deposits; the remainder from Tertiary rocks.

The Pleistocene volcanic ash of the Great Plains occurs in many distinct and separate deposits. Apparently this ash was at first distributed by wind over the Great Plains to a depth of but a few inches and later accumulated into dunes, some of which were driven into protected areas where they have been preserved to the present time. Most of the Tertiary ash, on the other hand, was deposited in large interior lakes, where it became interbedded with other sediments. The areal extent covered by such deposits depends then upon the size of the original body of water and upon the extent of recent erosion. What is known as the White Ash layer in the White River beds of Oligocene age has been found over a large area in southwestern South Dakota and adjacent parts of Nebraska and Wyoming.[1]

The source volcanoes for the Pleistocene ash are thought to be members of the Capulin group in northeastern New Mexico.[2] The Tertiary ash beds of the Great Plains area no doubt also originated through volcanic activity in the Cordilleran area. The ash deposits occurring within the Cordilleran and Pacific Coast regions are without doubt the results of volcanism in those provinces.

III. Deposits in Different States[3]

Most of the states in the Great Plains, Cordilleran, and Pacific Coast provinces contain deposits of volcanic ash of commercial importance. Deposits are also known in some of the western provinces of Canada and in Alaska.

South Dakota

Hatmaker states that a deposit of volcanic ash at Winner in Tripp County is exploited for use in the manufacture of powdered soap. The age of this ash is not given. The Oligocene White River formation of the Black Hills region contains a layer of volcanic ash of widely varying thickness. In the Bad Lands of southwestern South Dakota it has an average thickness of about 15 feet, but locally, as at Sheep Mountain, it may be much thicker. This layer extends to the south into Nebraska and to the west into Wyoming, but it is thinner there than in the Black Hills. Attempts have been made to exploit this ash southwest of Custer, South Dakota.[4]

Nebraska

Volcanic ash is being mined at Eustis in Frontier County and at Ingham in Lincoln County. Large deposits exist, however, and have been exploited in Harlan County, especially near Orleans, and in Furnas County near Edison. Other volcanic ash localities in Nebraska are near Arnold in Custer County, near Scotia in Greeley County, at Atkinson in Holt County, and near Royal in Antelope County. In addition, the volcanic ash-bearing White River beds cover northwestern Nebraska, and outcrops of ash have been noted at Adelia in Sioux County and near Scottsbluff. Most of the Nebraska ash is of Tertiary age, but the deposit being exploited near Eustis is Pleistocene.[5]

Kansas

For a number of years, Kansas has been the leading pro-

* Presented at the Fortieth Annual Meeting, American Ceramic Society, New Orleans, La., March 29, 1938 (Materials and Equipment Division). Received April 7, 1938.

[1] J. P. Connolly and C. C. O'Harra, "Mineral Wealth of the Black Hills," *South Dakota School of Mines Bull.*, No. 16, pp. 333–35 (1929); p. 335.

[2] K. K. Landes, "Volcanic Ash in Kansas," *Bull. Geol. Soc. Amer.*, **39**, 931–40 (1928).

[3] General references consulted, (*a*) Paul Hatmaker, "Pumice and Pumicite," *U. S. Bur. Mines, Information Circ.*, No. 6560, 23 pp. (March, 1932); *Ceram. Abs.*, **11** [7] 397 (1932).

(*b*) Annual volumes of Minerals Yearbook, U. S. Bureau of Mines.

[4] (*a*) H. R. Wanless, "Stratigraphy of the White River Beds of South Dakota," *Proc. Amer. Phil. Soc.*, **62** [4] 252–55 (1923).

(*b*) See also footnote 1.

[5] (*a*) E. H. Barbour, "Notes on Ash Beds of Nebraska and the Great Plains," *Mineral Ind.*, pp. 22–25 (1897).

(*b*) E. H. Barbour, "Nebraska Pumicite," *Nebraska Geol. Surv.*, **4** [Part 27] (1913) (distributed November, 1916).

(*c*) A. L. Lugn, "Pleistocene Geology of Nebraska," *Nebraska Geol. Surv. Bull.*, No. 10 [2d Series], p. 201 (1935).

ducer of volcanic ash in the country. Most of this production comes from Meade and Norton counties, but large reserves are known to exist in Phillips and Jewell counties, and many smaller deposits occur in about twenty other counties. The largest deposits occur in that part of the state contiguous to the 100th meridian. The Norton County ash is of Tertiary age, but most of the rest is Pleistocene.[6]

Oklahoma

A deposit of volcanic ash near Gate in the Oklahoma Panhandle, with a reported thickness of 80 feet, has been exploited in recent years. A number of other deposits are known in Woodward, Wood, Kay, Blaine, and Custer counties in the northwestern part and along the Canadian River in east-central Oklahoma. The ash in the valley of North Canadian River in Okfuskee County has been exploited to some extent.[7]

Texas

Large quantities of volcanic ash are available in Texas, but little or no attempt has been made to exploit this material. Potentially commercial ash deposits of Pleistocene age occur in northwestern Texas, especially along Duck Creek in Dickens and Kent counties. Some of the deposits exceed 18 feet in thickness and cover many acres. Volcanic ash beds of Tertiary age occur in many counties on the Gulf Coastal Plain. In places, this material has been altered in part, or wholly, to bentonite. Some of the Tertiary ash beds occur in the Fayette and Jackson formations of Eocene age; others, in the Gueydan formation of Oligocene age.[8]

Louisiana

W. M. Weigel reports the occurrence of a volcanic ash deposit with commercial possibilities near Columbia in Caldwell County.

New Mexico

A deposit of volcanic tuff at Grants, New Mexico, is being actively exploited. The tuff is ground and marketed as domestic pumice.

Colorado

Several deposits of volcanic ash have been discovered in eastern Colorado, especially in the vicinity of Wray. Scattered deposits also occur in the mountainous area.[9]

Wyoming

The White River formation of the Black Hills region extends into Wyoming, and the existence of volcanic ash in this formation has been noted in the Goshen Hole region of the southeastern part of the State. A deposit has also been discovered in southeastern Albany County near the Colorado boundary.[10]

Montana

At least sixteen counties in Montana contain volcanic ash deposits. The largest deposits are found in Gallatin County, especially in Gallatin Valley northwest of Yellowstone Park, where a series of 5-foot beds of pure ash occur interbedded with thick layers of pumiceous material. The Montana ash deposits are thought to be due to deposition in Tertiary lakes of ash blown from near-by volcanoes.[11]

Nevada

A deposit of volcanic ash has been reported in northern Nevada, but no further information is available as to its location. Hatmaker reports that extensive deposits occur in this State, but there is little or no production.

Arizona

Production of volcanic ash has been reported from a deposit at Bouse in Yuma County.

California

More than twenty companies have reported production of pumice and volcanic ash in California during the last few years. According to Hatmaker, the main volcanic ash production comes from Fresno, Mono, Kern, and San Luis Obispo counties. Deposits are known, however, in other counties, including Merced.

Oregon

An enormous volume of pumice and, to a lesser extent, ash, occurs in the district surrounding Crater Lake. Many hundreds of square miles are covered by pumiceous material with a maximum thickness of about 100 feet. Some exploitation has taken place near Chemult in Klamath County. Volcanic ash deposits have also been noted in northeastern Oregon.[12]

Washington

Volcanic ash is known to occur in the vicinities of some of the volcanic peaks of this State, such as Mount St. Helens.

Canada

Attempts have been made to exploit a deposit of exceptionally fine ash near Beverly in southern Saskatchewan.

IV. Production and Reserves

An average of about 60,000 tons of volcanic ash (and pumice), valued at about $250,000, has been produced in

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[6] (*a*) K. K. Landes, "Volcanic Ash Resources of Kansas," *Kansas State Geol. Surv. Bull.*, No. 14 (1928).
(*b*) See also footnote 2.
(*c*) G. L. Knight, "Volcanic Ash in Norton County, Kansas," *Trans. Kansas Acad. Sci.*, **34**, 166–67 (1931).

[7] (*a*) Frank Buttram, "Volcanic Dust in Oklahoma," *Oklahoma Geol. Surv. Bull.*, No. 13 (1914).
(*b*) J. H. Gardner, "Volcanic Ash in North Canadian Valley, Oklahoma," *Bull. Amer. Assn. Petroleum Geol.*, **7** [5] 576–78 (September–October, 1923).

[8] (*a*) C. L. Baker, "Volcanic Ash in Texas," *Univ. of Texas Mineral Resource Circ.* (Bur. Econ. Geol.), No. 2 (December, 1931).
(*b*) J. A. Udden, "On the Trail of a Catastrophe (Deposit of Volcanic Ash in Kent County, Texas)," *Texas Mag.*, **7**, 242–44 (1913).
(*c*) H. A. Turner, "Volcanic Dust in Texas," *Science* [New Series], **1**, 453–55 (1895).
(*d*) R. A. Jones, "Surface Geology of Northwest Part of Government Wells Producing District, Duval County, Texas," *Oil Weekly*, **74** [7] 22–26 (July 30, 1934).

[9] L. H. Woolsey, "Volcanic Ash near Durango, Colorado," *U. S. Geol. Surv. Bull.*, No. 285, pp. 476–79 (1905).

[10] N. H. Darton, "Laramie-Sherman Folio," *U. S. Geol. Surv.*, No. 173, p. 15 (1910).

[11] J. P. Rowe, "Some Volcanic Ash Beds of Montana," *Bull. Univ. of Montana Geol.*, Series No. 1 (1903).

[12] B. N. Moore, "Diatomite and Pumice in Eastern Oregon," *Amer. Inst. Mining Met. Engrs. Contrib.*, No. 73 (1934).

the United States during recent years. As there are any number of single deposits which are known to contain close to a million tons or more of volcanic ash, it is apparent that present exploitation is not making any serious inroads on the reserve supply of this material. In addition, the enormous sheets of pumice occurring in the western part of the United States greatly increase the potential reserve, for pumice can be ground and used for most of the same purposes to which volcanic ash is put.

Acknowledgment

The author wishes to acknowledge the courtesy of J. H. Cowell, president of the Mid-Co Products Company, Kansas City, Missouri, in supplying information, which was not elsewhere available, regarding deposits of volcanic ash.

STATE GEOLOGICAL SURVEY OF KANSAS
LAWRENCE, KANSAS

GEOLOGY OF THE NONMETALLICS OF THE SOUTHEAST*

BY STEWART J. LLOYD

I. The Pre-Cambrian (Crystallines)

The accompanying map divides the Southeastern territory into three main divisions, the first of which includes the old, old rocks, the Crystallines (pre-Cambrian) which have solidified from a molten condition or have been squeezed, pressed, and heated until they are out of shape. Sometimes they are known as the igneous and metamorphic rocks. They will probably average more than a billion years in age, and they have stood uncovered above the sea throughout their life. Granites, diorites, gabbros, peridotites, schists, porphyries, slates, and phyllites make up their bulk. Practically no oil, coal, or fossils are present in them; indeed, they have sometimes been called the "Azoic" or lifeless rocks. There are plenty of them in the world; for example, these rocks occur in two-thirds of the tremendous area of Canada.

In the Southeast, however, they contain a variety of valuable nonmetallics. The residual, primary, low plastic kaolins occur here. Small deposits are scattered along the belt from Alabama to Virginia, but only in North Carolina have they attained commercial development. The commercial feldspars occur in pegmatites also all along this belt, but again only in North Carolina do they receive commercial exploitation; at least one-half of the feldspar in the United States comes from North Carolina. Kyanite is likewise in this division, extending from Alabama, but only in Georgia and North Carolina is there active production. One of the best graphite districts in this country lies in east Alabama. Although, in 1918, more than twenty-five mines were in operation there, only one is active at the present time. Nelsonite, the peculiar rock containing titanium and apatite, is mined and processed at Piney River in Virginia. A large deposit of vermiculite, to be used for house insulation, has recently been developed in Greenville, South Carolina. Amphibole asbestos occurs in Alabama and Georgia, with some production in Georgia. Olivine, pyrophyllite, chromite, talc, spodumene, topaz, mica, sillimanite, and corundum occur in this division, with moderate production in some cases. North Carolina, in particular, holds numerous rather rare minerals, some of which may later be placed in production. For example, there is a demand for perofskite, a rare calcium titanium mineral. If this mineral occurs at all in this territory, it should be found in the Crystallines, probably in North Carolina.

II. The Palaeozoics

The second area on the map represents what is known as the Palaeozoics, which range from 700 to 250 million years in age and which were practically all laid down under water. These rocks are the great coal containers of the world, in general, and occur in Kentucky, Tennessee, and Alabama. In addition, they hold most of the iron ores in the Southeast, notably the Birmingham red ores. Hard, compact, well-consolidated beds make up nearly all of these Palaeozoic rocks, with limestone, sandstone, shales, quartzites, and conglomerates predominating.

The secondary clays of various kinds occur in these rocks; among these are refractory fire clays, associated with the coal seams, and occasional freak clays like those at Eastaboga, Alabama. The writer does not know of any primary residual clays in this division, although they may exist. Tremendous amounts of shale, especially in the Coal Measures, characterize this territory, and they are the raw material for much of the brick production here.

Compared with the information on clay minerals, there has been little research available in the literature on shales, which are only hardened clays.

Silica (or flint) in most of its forms is obtainable in the Palaeozoics, as tripoli in Tennessee and Alabama, quartzite in east Alabama, and glass sand from the crumbly sandstone along the Coosa River. Fluorspar is found only in northwest Kentucky, phosphate rock in Tennessee, bauxite in Tennessee and Alabama, and ochre at Cartersville, Georgia. Salt and gypsum occur only in one locality in the Palaeozoics, *i.e.*, at Saltville, Virginia. Bentonite exists in this area, occurring in thin beds among limestones. Barite is found in Georgia, Alabama, and Tennessee.

III. The Coastal Plain

The third area on the map covers what is known as the Coastal Plain, though Cairo, Illinois, which is on its inner edge, is far from the present coast. The name is also a misnomer in that much of the country is rough, with high relief; indeed, there is a railway tunnel at one place through the Alabama Coastal Plain. The rocks are predominantly unconsolidated, made up of sands, clays, and gravel; soft limestones and occasional hard siliceous layers do occur. These were largely laid down under water, and they range in age from 200 million years to present-day formations.

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The South Carolina, Georgia, Florida, and Alabama sedimentary kaolins occur here, as well as the ball clays of Kentucky and Tennessee, which at times merge into fire clays. Bauxite is found in southeast Alabama and northwest Mississippi as well as in the Palaeozoics. Glass sand

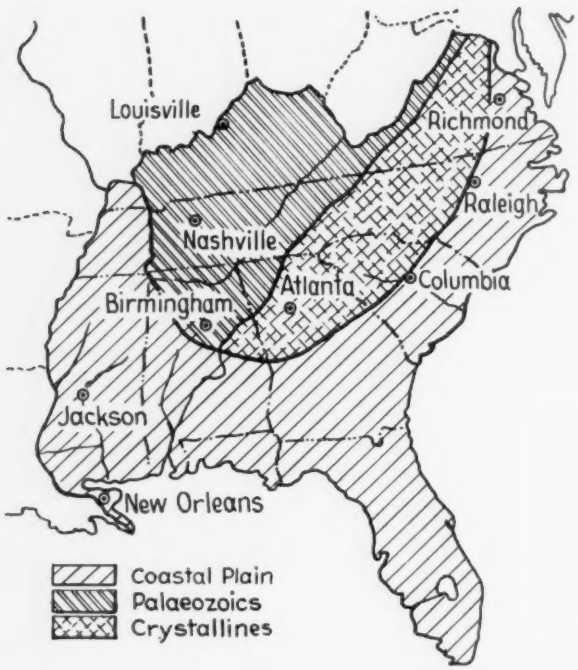

FIG. 1.

is found along the Alabama Gulf coast, and salt domes, recently discovered, occur at least in two places in Mississippi, near Hattiesburg and west of Jackson. Bentonite is mined in west Mississippi at several places. Fullers' earth exists in large amounts in north Florida, with smaller deposits elsewhere in the Coastal Plain. Diatomaceous earth, a form of silica, occurs near Milton, Florida, and small ochre deposits are found at many places; lignite coal in quantity appears in Alabama and Mississippi. In general, the existence of enormous amounts of clays of all compositions makes the Coastal Plain an attractive place for clay prospecting.

IV. Alluvial Clays

This division of nonmetallics into three ages, Crystallines, Palaeozoics, and Coastal Plain, however, omits one important type of clay occurring in all of them. This is the alluvial material that occupies the flood plains of many streams and rivers and which furnishes a large proportion of the raw materials for brick. The alluvial clays occur in each of the three divisions, along favored streams, but are not represented on the map.

A comparison of the areas of these three primary divisions reveals the fact that the Crystallines cover approximately 85,000 square miles; the Palaeozoics 100,000; and the Coastal Plain 240,000, a total of 325,000 square miles.

There is an erroneous idea that in a country settled as thickly as the Southeast, all discoveries of important minerals have already been made. Geophysical methods of exploration like those used in searching for oil will help discover numerous unknown deposits in this territory. Even without these methods, there are great possibilities of developing new deposits. In the county of Kent, England, coal was discovered only about thirty years ago, although that County has been thickly settled since before the Romans came. A large iron ore district was found recently in India, near Calcutta, in one of the most densely peopled regions of the world. In the Eighteenth Century, white kaolin was exported in quantity from South Carolina to England, although the famous Cornwall clay region had been settled for 2000 years. There are many useful nonmetallics awaiting discovery in the Southeast.

DEAN, SCHOOL OF CHEMISTRY, METALLURGY, AND CERAMICS
UNIVERSITY OF ALABAMA
UNIVERSITY, ALABAMA

GLASS SANDS OF ALABAMA*

By Walter B. Jones

I. Introduction

Although silica in the form of sand, gravel, sandstone, conglomerate, quartz, and quartzite is widely scattered throughout Alabama, it is now thought that there are only two deposits which are satisfactory for the manufacture of high-quality glass. These are the Mohawk deposit near Ohatchee, Calhoun County, and the Gulf Beach sands of South Baldwin County.

II. Distribution

In the nearly nine thousand square miles of Coal Measures in Alabama, there are five conglomerates and numerous beds of sandstones, almost any of which could be used for colored glass. There are, likewise, great quantities of sand belonging to the Tuscaloosa formation, of Cretaceous age, which would be suitable for common glass. The same is true of many other sands in various formations in the Gulf Coastal Plain region. Similar to the Coal Measures beds is the Hartselle sandstone of Mississippian age, some 200 feet thick, occupying a rather large area in north Alabama. This sandstone was used years ago at Gate City, Jefferson County, for the manufacture of glass. It is comparatively high in iron. The Weisner quartzite, of Cambrian age, occurs in great abundance in northeastern Alabama and is suitable for glassmaking. The material from the Weisner formation, however, is difficult to process because of its tough, compact nature.

Perhaps the best source of high-quality sand in Alabama is from the Shades sandstone or basal conglomerate of the Coal Measures formation. It is in this formation that the Mohawk deposit occurs. The Shades sandstone (also known as Millstone grit) forms the cap of Lookout Mountain, Sand Mountain, and various outliers of the Cumberland Plateau, particularly in the Tennessee Valley region. It varies in thickness from 40 to perhaps 200 feet. Generally, it is a white sandstone or conglomerate, ranging from 93½ to 99½% SiO_2; almost everywhere, it is comparatively low in iron oxide. Most of the impurities present are finely divided particles of clay.

There are really only two deposits of glass sand in the State suitable for the production of high-quality glass, namely, the Mohawk and Gulf Beach deposits.

III. Glass Sand Deposits

(1) Mohawk

The Mohawk deposit is a massive bedded sandstone and conglomerate, varying in thickness from 40 to 80 feet. The beds belong to the Shades sandstone formation of lower Pottsville age, and the Mohawk deposit occupies the northeasternmost extension of the Coosa Coal Field, a synclinal plateau. The synclinal pitches sharply to the southwestward, passing underneath the Coosa River about two miles from the northeastern limits of the deposit.

In texture it varies from a medium, fine-grained sandstone to a conglomerate consisting of small, water-worn pebbles. The color is generally white, except in scattered water seams where some iron oxide has been deposited by percolating surface waters.

The rock is soft except where it has been exposed to the weather, particularly along the face of the cliff which occupies the northern part of the deposit. Back from the face of the cliff, however, the rocks become friable and easily pulverized. Freshly quarried material may come out in boulders, but they disintegrate quickly after exposure to air and rain.

The sandstone is almost pure quartz. The pebbles forming the conglomerate consist of white quartz. The iron present is in the form of a stain and is usually confined to joint and bedding planes to which surface waters have had access. Little alumina is present, and it is usually in the form of clay, cementing the sand grains. The beds are remarkably pure and uniform, average samples representing the whole outcrop, which is 40 feet thick, with 98% SiO_2; washed samples carry 99½% SiO_2 and are low in iron oxide. Some washed samples have carried as little as 0.0025% iron oxide. Excellent plate glass has been manufactured from this sand. It is believed that carefully processed sand from this deposit is sufficiently high in quality to make lens glass.

Outcrops and test pits have disclosed an enormous tonnage of material, conservatively calculated at 100 million tons. There is scarcely any overburden in any part of the deposit. The tract is one mile square and is about three miles northwest of Ohatchee, through which the Seaboard Air Line Railway passes. Ohatchee is 57 miles from Birmingham, Alabama, and 110 miles from Atlanta, Georgia. The Coosa River is immediately adjacent to the deposit, which is about 275 feet above the normal stage of the river. Therefore, an abundance of water is available. Likewise, if present plans for improving navigation on the Coosa River materialize, water transportation could be utilized to great advantage. Almost any part of the deposit could be worked by gravity flow through the processing mill, and the finished product could be loaded either on barges or cars at the foot of the mountain.

The deposit is now under lease and early production is expected.

Typical analyses[1] from samples collected December 14, 1926, are as follows:

	(%)
Silica (by difference)	99.57
Iron oxide	0.09
Aluminum oxide	0.13
Calcium oxide	0.08
Magnesium oxide	Trace
Ignition loss	0.13

Note: In the preparation of the sample of sand for analysis, care was taken to keep the introduction of impurities during the grinding operation at a minimum. The sample was first crushed on a hard steel plate, and a small

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[1] Analyst, R. S. Hodges, chemist, Geological Survey of Alabama.

portion of this was finally ground in an agate mortar. The hydrofluoric acid method of analysis, the silica being obtained by difference, was chosen as affording less opportunity for the introduction of impurities than the fusion method which requires a relatively large amount of reagents.

The mechanical analysis is as follows:

	(%)
Passing 200-mesh sieve	2.8
" 80 " "	7.3
" 40 " "	42.2
" 20 " "	39.2
" 10 " "	7.1
" 4 " "	1.4
	100.0

(2) Gulf Beach Deposit

This deposit comprises a thickness of some twenty feet or more of beach sand, extending entirely across the southern end of Baldwin County, Alabama. Near the surface, particularly in swampy areas, there are a few thin layers and stringers of ferruginous material, but it is thought that these can be eliminated by stripping or washing. Most of this deposit will average 5 feet above to 15 feet below sea level. Production, therefore, would be by dredging. While the Gulf Beach deposit is somewhat higher in iron and lower in silica than the Mohawk deposit, it is satisfactory both in grain size and quantity; furthermore, the deposit is pierced from end to end by the intercoastal canal, which affords ideal transportation facilities. As yet there has been no developmental work in the area.

A typical analysis of a sample collected by the writer in 1936 is as follows: iron 0.201%, silica 98.9%, and ignition loss 0.331%.

STATE GEOLOGIST OF ALABAMA
UNIVERSITY, ALABAMA

METALLIZING IN THE POTTERY INDUSTRY*

BY G. W. JARMAN, JR.

I. Introduction

Metallizing, or the application of a coat of metal to a surface, is not a new art. The methods of applying a metal coat vary from dipping in molten metal, such as galvanizing; electroplating; spraying the metal through an oxy-acetylene flame; or the application of metal by use of a solvent or drier in which the metal particles are suspended and which evaporates after application. Of these methods, only metal spraying will be discussed in this paper.

II. Spraying Methods

Metallic spraying has been known since about 1870, although other types of metallizing extend back into the early ages. Three methods of spraying have been developed, *viz.*, (1) molten metal fed to a jet of compressed air; (2) metal which has been formed into wire, feeding this wire into a flame and a jet of air; and (3) powdered metal, feeding through a flame by means of air.

In each of these methods, a small particle of metal becomes either molten or plastic and proceeds with high velocity against a surface where impact occurs and adhesion results. Viewed under the microscope, the particles appear to have "splashed" against the surface and the next particle which comes along also adheres either to the previous particle or to the bare surface. Some of the particles are so fine that they penetrate into the pores of the surface being coated.

The feeding of a metal in a molten condition from a pot suspended above the work is obviously hazardous, not readily transportable, and, of necessity, its application is limited.

The second method of feeding wire through a pistol has had widespread use. The disadvantages of this application are the uneven size of the melting particles which are torn off by the air during the feeding of the wire through the flame, resulting in a lumpy surface; the relatively slow rate of feed; and other factors resulting in a high cost per square foot. The advantage is its ability to handle high melting-point material, such as stainless steel and high carbon steel.

The third method, spraying with mixtures of powder, such as metallic zinc, copper, aluminum, lead, tin, brass, or bronze, or mixtures of silica or glass powder mixed with metallic powders, has recently had extensive research abroad. It is known as the "Schori process." A finer and more even coating is achieved, and the cost of the raw materials in powder form is considerably less than of those in wire form. Its limitation is that it can not handle successfully the higher melting-point materials that can be handled by the first and second methods.

III. Types of Application

(1) Decoration

The first application which comes to mind in the pottery industry is that of decoration. Pottery coatings may be sprayed over the entire surface and all work must be done on the biscuit. These coatings permit either wire brushing or burnishing to a high finish. Thus, there are three possibilities of textures, *viz.*, (1) a rough appearing, dull metallic coat; (2) a semilustrous coat; or (3) a coating buffed to a high polish.

Coatings vary in thickness with the metal which is put on; for example, copper goes on at about 0.001 inch per passage of the pistol over the surface being sprayed; zinc and aluminum go on to a depth of 0.002 to 0.003 inch per passage of the pistol. The costs per passage are of the order of 2 cents per square foot for flat surfaces of zinc; 5 cents for copper; 4 cents for aluminum.

(2) Strengthening

The second interesting point to be studied is the strengthening factor against chipping and cracking. Dinnerware will stand a much sharper blow without chipping when it has a metallized surface. It is also possible to coat the outside of Pyrex-brand glass containers with

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metallic coatings, which will enable these dishes to be put on top of the flame on a stove. This metal, of course, could be buffed and would require no glazing.

Another possible use is the coating of setters and saggers with nickel powder. If they can be coated with something which will stand the heat and which will prevent cracking and chipping, a great step forward has been achieved. It would also be possible to re-surface these after use. This type of setter is now being experimented with in England by the powder method of metallizing.

(3) Insulators

By far the greatest industrial use which has been actively used commercially is placing a metal surface on top of insulators against corona discharge, etc. The Schori process has enabled metallizing to be placed on the inside of insulator tubes. This method of treatment is in wide use in England and to a lesser extent in this country, and rapid progress is being made in its development.

(4) Other Uses

Other uses in the ceramic industry include the interior of radio tubes, as practiced by the Phillips organization in Belgium and England. Metallizing with woven fiber glass formed into a wire with a zinc covering has had extensive experimentation recently. The New York State College of Ceramics has conducted research on the use of the wire process.

The data in the newly opened field of the Schori process are recent. There has not been sufficient time since its introduction into this country to have available the necessary critical data with break-down tests, etc.

England and Europe are far ahead of the United States in the use of these coatings. This metallizing treatment has been presented here for the purpose of pointing out the possibilities (1) of increasing the potters' sales by means of unusual decoration, (2) of benefiting the insulator manufacturer by applying a more tenacious coat, and (3) of informing the stove manufacturer of European developments.

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CERAMIC MATERIALS OF OLD LOUISIANA BUILDINGS*

By Richard Koch

Because there are no stone quarries in southern Louisiana, it was inevitable that ceramic structural materials would develop early to supply a building material that would not deteriorate quickly in the low, swampy country in which the first buildings were erected. Brick made from fired river sand, a clay deposit of the Mississippi River, was the solution, and the early instructions for the building of New Orleans state that brick kilns were to be built immediately and illicit salt smugglers were to be available as brickmakers.

On old maps of New Orleans, these brick-yards are found scattered along the river front, and in the Cabildo one map shows at the foot of Esplanade Street the brick-yard of Marigny, the wealthy landowner of the early city. North of the Fair Grounds was Brickyard Street and in Gentilly was the brick-yard of Mathurin and Pierre Dreux. In his book, New Orleans as It Was, Henry Castellanos tells of a deserted pottery in the Raquette green along St. Bernard Canal. A plan of the city of Jefferson in the Notarial Record Office shows on the river front the brick-yards of Fortier, Dinners, and Duguer.

There were also extensive brick-yards in and about Bayou Liberty. The brick were shipped across Lake Pontchartrain by schooners to New Orleans and unloaded at the Carondelet Canal, a continuation of Bayou St. John. This Canal has since been filled in.

Miss Mary Delavigne, whose family were old brick-makers, has written this interesting letter:

"The heavy clay, dug from the bottom of the canals, is mixed with a certain proportion of river sand; this is put in a pit about one foot more or less deep, together with sufficient water to soften it. It is worked by means of a very large wheel, I should think about five feet in diameter, which slides back and forth on a horizontal shaft drawn by two mules (generally old ones) very slowly.

"When the mass is ready and can be worked easily, it is brought by wheelbarrows to the brick sheds; here, negroes take enough dough for one brick and throw it with force into the mold, the bottom of which was previously dusted with river sand.

"The molds are three bricks long and when they are filled, a wire is used to even up the top. The molds are then turned upside on a shingle and the bricks are detached and dropped on the board, put on shelves in a long drying shed, and allowed to dry for one week or more according to the weather.

"When dry, the bricks are stacked in the kiln, which usually contains several thousands, and fired for a week or ten days. The fire is started very slowly, then increased till the whole kiln is at white heat. This is watched by a man who walks around on the top of the walls of the kiln twice a day. When this point is reached, the fires are banked and the kiln gradually cooled.

"I believe the whole process may be found in any book on brickmaking and may be more accurate than the little I remember.

"There were several brick-yards in the Parish of Orleans up till about 1888 or 1890. The Eagle brick-yard below the Ursuline Convent, where is now the Industrial Canal, was operated by Alfred Delavigne; one uptown, Van Hoven; and a third of which I do not recall the name. There was one in St. Bernard Parish, I believe, near the Orleans Parish line, operated by Mr. Roy. Van Hoven's brick-yard was somewhere near Louisiana Ave., and the Eagle brick-yard was founded about 1824 by a man named Jourdan."

The old brick made by hand varied in size, were rather rough in texture, and were red and orange in color. They were soft and porous, but, as the operation of kilns improved, the brick later lost their color and hand-made texture. That is why today, in using old brick for old

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effects, care must be made in the selection or the wall will be a dirty yellowish gray, the color of the brick made during the last fifty years.

It is the tradition that the brick for many of the old plantation houses were made on the site. In the rear of W. W. Hall's house (HABS No. La. 75) in New Iberia, it can still be seen where excavations were made near the bank of the Teche, and at Parlange (HABS No. La. 34), in New Roads, the molds are preserved from which the round brick for the columns were made.

Recently, in the Cabildo, a closet under a stair was opened and the old brick were found to measure $8^3/_4$ by $3^7/_8$ by 3 inches and 8 by $3^7/_8$ by $2^3/_4$ inches, the sizes varying.

The early type of Louisiana house is interesting because it was a medieval form of construction brought here from the West Indies, where the French had settled the islands of Guadaloupe, Martinique, and Santo Domingo for one hundred years and where they had developed a building suitable to a tropical climate, derived from the small farm house of France. Their houses, perhaps only one room deep with a porch front and rear, were raised off the ground a low story height. The walls of the lower floor were built of brick and the floors were paved with brick tile. One is found at Ormond Plantation (HABS No. La. 13). This lower floor was not always used because the country was often flooded from the high waters of the Mississippi. (At that time, there were no adequate levees to protect the country.) The walls of the second story were of medieval construction, a wood frame filled in with brick and coated over with plaster or weather-boards. This construction was known as *briqueté entre poteaux*, and many examples may still be found. Lafitte's Blacksmith Shop at 941 Bourbon Street (HABS No. La. 24), a low one-story building and one of the few left from the French régime, in its dilapidated condition shows well this construction, and the early hand-made brick with mortar of shells can easily be seen.

New Orleans, like all old cities built mostly of wood, suffered from fires, and its present character is due partly to the efforts of Baron Carondelet, the Spanish Governor. After the disastrous fires of 1788 and 1794, he offered a bounty to those who built walls of brick and roofs of tile. On October 9, 1795, the City Council adopted the following building regulations:

"I certify and give faith that at the meeting of the City Council today the (Sindico Procurador General, Don Miquel Fortier) Trustee Attorney General, Don Miquel Fortier, in fulfilment of the charge placed with him at the previous meeting, communicated his opinion, in order to avoid recurrences of fires in the future, such as the ones experienced in this city in the years of eighty-eight and ninety-four ultimo, that all the high houses or of two floors shall in future be constructed of bricks or of lumber with bricks between the posts, these to be covered with tiles or bricks or platform roofed, that the frame house must be covered with mortar, and the low houses must not be more than 30 feet in depth including galleries. That all the houses, be they of wood or brick, must exactly face the street, although no one can build them with the rafter joining another house unless by those whose lots measure less than 30 feet front. The members of this Council took due note of the above communication; they found it useful to this community and resolved to accept same and that they would request the Governor and the President (of the City Council) to order published the above proclamation, so that, once known to the public, they shall conform to these regulations in their future building. In the city of New Orleans on the 9th of October of 1795."
Signed, Pedro Pedesclaux

Architecture with strong local characteristics usually develops from the peculiar use of materials native to a country and from the changes in the shape and materials of the roofs. In the case of New Orleans, the distinctive changes which are so marked are due not only to the use of these materials, but also to the type of materials imported. Neither France nor Spain allowed Louisiana to trade freely with the outside world. I doubt whether France shipped much roofing material to Louisiana during her régime, for the identical hipped, high-pitched roofs in the West Indies were and still are covered with shingles as we know they were in Louisiana; but with the Spanish régime and after the fires of 1788 and 1794, half-round Spanish tile were imported from Havana in exchange for barrel staves and lumber. With a change in government, the aspect of New Orleans changed, and the new houses of the Spaniards were built with very flat roofs, gabled, and laid in a most ingenious manner. The roof rafters were cut in the form of a triangle and spaced about 8 inches apart. In the trough thus formed was placed round tile with about a 3-inch lap. The cover tile was then laid in cement over the ridges formed by the edges of the tile and the point of the rafter; this heavy mass on such a flat roof was secure from slipping and did not need flashing. I am afraid these roofs were not too successful in this wet climate for there are none left. The last to go were the slave quarters of Roark Bradford's house (Peychaud House, HABS No. La. 41) in Toulouse Street and another outbuilding in Dauphine Street. The construction described was found in the Casa Flinard (HABS No. La. 33), the house next to that of Roark Bradford, which later was slated, and I remember seeing a building demolished with such a roof where the Annex of the Maison Blanche is now located.

The Spaniards also used flat roofs, but none remain. Old pictures show these terraces, and a sample of a tile, perhaps from the Spanish days, is shown.

The specifications for the terrace of Tremoulet's Hotel are for such a roof and, as written by a French architect in the beginning of the American régime, are quite interesting:

. . . . . when this is perfectly dry, a coat of boiling tar will be given on which will be thrown lime until complete liquidity disappears. Upon this will then be placed a double thickness of building paper, which shall previously have been bathed in boiling tar; the whole, now carefully placed and tarred over. This layer of paper shall be covered with a cement mortar over which shall be laid small square tiles of tiny pattern and of good quality; they shall be sprinkled repeatedly with a mixture of cement and quicklime if obtainable. The cement will be made with pieces of ordinary tile, or of Pensacola tile; or of northern brick.

New Orleans, in spite of its many political changes, has always kept its French character, and what is French today was brought chiefly by Frenchmen from the islands of the West Indies, who were driven out by the insurrections there at the end of the Eighteenth Century. New people importing new building materials bring a new style, and the low flat roofs of the Spaniards were abandoned for the

high-pitched roofs of the French and also for the American styles; these roofs, covered with a flat pantile, have given many of these buildings the feeling as if belonging to a small town in France. The tile were held in place by a hook fired in the tile that fitted into the purlins of the roof construction, and their color was originally a grayish white, now a russet green, which modern roofing makers have tried in vain to imitate. Many examples may still be seen. The Girod House (HABS No. La. 9) at the corner of Chartres and St. Louis streets is the best example of this period.

With the common use of brick so evident here, one would naturally expect to find examples of brick vaulting in an effort to make the buildings fire-proof. There was little done (the lack of adequate foundations probably being the reason), but two examples are outstanding. In 1821, after the design of Latrobe, the main banking room of the Louisiana Bank (HABS No. La. 8) was covered with a flat brick vault. The height from the floor was 21 feet, $5^1/_2$ inches; the diameter 36 feet, $2^1/_4$ inches; and the arch radius 27 feet, $1^9/_{16}$ inches (intersecting vaults and arches, 19 feet, $11^1/_2$ inches high).

The thrusts of the vault were taken care of by four heavy piers and further strengthened by the small rooms at the four corners. In fact, the plan is that of a cruciform church. An examination of the vault some years ago showed that it is in excellent condition. This building, at the corner of Royal and Conti streets, and now occupied by Manheim, well repays a visit.

Of greater interest was the dome of the old St. Louis Hotel, and it is deplorable that it was destroyed. For information regarding this dome, the writer is indebted to N. C. Curtis of the Department of Architecture at Tulane University, who came to New Orleans just before its destruction. The St. Louis Hotel, famous in the history of old New Orleans as the meeting place of the planters during the gay winter seasons, was begun in 1836 and finished in 1840. The architect was Jacques de Pouilly, born and educated in France. He came to New Orleans in 1830 and had a successful practice here as an architect, where his work shows him as a man with a vivid imagination. Owing to his French training, his buildings were influenced by Roman models instead of by Greek, which was then the popular style. The circular rotunda built in the axis of the main entrance and that of the Citizen's Bank recall the Pantheon at Rome with its colonnade of Corinthian columns and its coffered dome, but it is the construction that interests us. It was to the early Christian churches of Ravenna that the architect went for his inspiration, the Orthodox Baptistry and the Church of S. Vitale, both built in a country similar to Louisiana as far as foundations are concerned.

The rotunda had a diameter of 66 feet; it was 86 feet high from the floor to the crown, with 38 feet from the spring of the arch to the lip of the dome. To support the weight of such a dome was a problem in a soil where, as Gallier in his autobiography tells us, the St. Charles Hotel (built at the same time) settled three feet, after $1^1/_2$ feet were allowed for the settlement. The problem was solved by building a light iron cage and filling this framework with earthen pots, 12 by 8 by 10 inches in diameter and $^3/_8$ inch in shell thickness. The shapes varied from cylinders in the lower courses to truncated cones, graduated to correspond with the diminishing diameter of the closing circles. The ends of the pots were merely closed and were laid with their axes along the radius so that the round ends were exposed; this was the reverse of the domes at Ravenna. Mr. Curtis has figured that the load on each pier was 25 tons and that, if it had been built solidly of brick, the weight would have been 100 tons, a weight that the soil would not have carried.

Because the early brick was not of a high quality, it was found necessary to cover the outside of the buildings with stucco. In the courtyards, however, the room walls were not exposed to the weather, and the design of the court wall could evolve into a system of arches of exposed brick.

These courtyards are not like those in Spain or France, but the idea came from the Mediterranean. The early New Orleans of the French was West Indian, and no doubt the Spaniards brought the arches seen in the courtyards, as they are vaguely reminiscent of Cordova or Majorca. Brick adapted itself to this development, but the West Indies' turned columns were kept for the upper porch.

A picturesque example of brick vaulting that must not be overlooked is the underground cisterns of the plantations, many of which still exist. Obtaining drinking water was always a problem, and rain water from the roofs was collected in underground cisterns made of brick. The writer knows of no examples in New Orleans, but Latour and Laclotte's specifications for the Tremoulet Hotel (HABS No. La. 191) and alterations to the Skyscraper (HABS No. La. 21) at the corner of Royal and St. Peter streets call for these cisterns. Two may be found at Ormond (HABS No. La. 13) at Darby and The Shadows in New Iberia, where the necklike drums project from the ground.

Because New Orleans was owned by Spain for so many years, it is natural to expect to find glazed tile like those of Spain and her colonies in Mexico or South America. That this is not the case perhaps may be explained by the fact that Spain did not colonize Louisiana but governed it. The Spaniards were officers or shopkeepers, not artisans. The architecture was French and, for the most part, built by mulattos from the West Indies and later, by Americans. There is one example, however, of ceramics used as a decoration in a panel of brickwork on the side of a small cottage near Washington, La. The early *briqueté entre poteaux* construction was filled in with a rich red brick and an unusual diamond pattern was worked with black glazed brick. At the top were two panels, one with the name of the owner, Lestraps, and the other with the date, 1803. The source of this unique piece of brickwork is not known, but such a design was common in Virginia and New Jersey during the 18th Century and was quite common in northern medieval Europe.

In New Orleans, we have materials and a climate that demand a different solution from the house of the East, and it is my hope that some day we, in this city, will realize, as in our past, that our future depends upon an individual local solution of our building problems.

District Officer, Historic American Buildings Survey
908 Queen and Crescent Building
New Orleans, Louisiana

PROBLEMS OF THE PRESENT-DAY ART POTTER*

By H. R. Bacher

I. Introduction

(1) Definition

The meaning of the term, "art potter," is indefinite; it is easy to define the term, "potter," but not "art." There is a small but vital species of potters whose interests lie in art, expressed in pottery, and who work as individuals or in a small group. They have entered this field as trained artists or as trained ceramists. Usually they are trained artists interested in ceramic processes as media to express their art. Their work presents a wide difference in results, but as they progress in their artistic and ceramic development, the final result is good art and good ceramics.

(2) Source of Fascination

Ceramic art has been described as the most "sporting" of the arts. This is true, for no matter what skill, feeling, or craftsmanship may be put into a piece of ceramic sculpture, the kiln has the last word. The ceramic artist can not, as does the painter, mix his colors and build his subject as he sees it before him. The potter must visualize the color effects he desires as they are to be after a heat treatment has profoundly changed these colors from the state in which they were applied.

II. Craft vs. Mass Production Ware

The first potters in America were individual craftsmen whose ware was made to fill the household needs of their community. As the country developed, these small shops grew into small factories and, with the advent of power and machinery, into larger organizations whose aim was to make ware equal to that imported from abroad. This they have succeeded in doing, but in the process they have lost the charm of ware freely made by skilled hands unhampered by quantity demands.

The type of potter under discussion came into existence when these highly efficient mass production potteries were well started. In the last ten or fifteen years, individual potters have been increasing rapidly in number. It is interesting to inquire into the reasons for this increase while the market is flooded with mass production pottery, from home and abroad, of all degrees of taste, and generally of low cost. The primary reason is that the press, stores, schools, and museums are creating an interest in the arts and crafts and a desire to possess the work of master craftsmen. There is also a revolt against machine-made "art products." The craft potters, moreover, are giving more attention to the needs of modern living and have lowered their prices so that their craftware is within the buying reach of more people.

Discriminating buyers expect that the work of craft potters will excel in design and decorative treatment. The decorative treatment may call for glazes of color and texture which are difficult to control and which the production plant does not attempt. As long as large volume at low cost can be sold, there is no need of complicating mass production by finishes that are not easily controlled. This situation will not last indefinitely, and there are numerous signs which clearly indicate that better designs and decorative treatment will have to follow more closely the leadership of the individual potter if the large plant is to survive. Ample proof of this is not hard to find.

With the innumerable variables in glaze development, the acceptance of the final result is a matter of personal preference. A glaze that one potter will consider worthless, another will use to make a beautiful pot. The beauty of a piece of pottery rests with an indescribable balance of feeling of form and choice of decorative treatment which a master may achieve with the commonest of glazes. As more exact knowledge of this complicated but fascinating subject becomes available to these potters, it will bear rich fruit. In the meantime, they are observing, experimenting, and producing beautiful results.

III. Equipment for Craft Potters

These potters have had to exercise a great deal of ingenuity in building their own equipment because there is little of the proper size at feasible cost. The difficulty of procuring a suitable kiln has undoubtedly been the greatest obstacle. With a rapidly growing market for a small capacity, short cycle, low-cost kiln of efficient design, these sales possibilities of such equipment should be attractive to some manufacturer. The electric kiln is still too expensive in first cost and in operation to be feasible in a majority of locations. If the problem can be successfully solved, it would offer the greatest technical help that these potters can be given and would do much to encourage new talent to enter the field.

The methods of forming the ware used by these potters are by building or coiling, throwing, and casting. Building or coiling can hardly be considered by the professional potter as the process is too slow even in the best of hands. It has a decided place, however, in schools and for those who make pottery for recreation and pleasure.

Many potters of the "throwing school" feel that any piece that is cast is among the "untouchables." Molds, however, were used by the early Egyptians. A well-thrown pot may or may not be a beautiful form; this must come from the feeling for it and no amount of skill in throwing will supply it. The casting method with proper mold design and workmanship, well-balanced bodies and slips, using core molds where possible, is not used as much as its merits warrant. This is probably because the method is complicated and because of lack of experience with casting slips.

The manner of forming the ware is of minor importance. It is the quality of the finished piece that counts, and each potter must use the method best suited to his own conditions.

IV. Price on Craft Pottery

Because they were unable to duplicate most of their work, some potters gained the idea that their productions were priceless. To be sure, many glazes do not often come out of the kiln identical on any number of pieces. The general character should be similar, and the particular

* Presented at the May meeting of the Baltimore-Washington Local Section. Received June 2, 1938.

variation from piece to piece a distinct advantage. The potter, however, will be asked, "Can we get similar pieces, a pair, a dozen, or a set?" The potter must be able to supply them.

V. Craftware Body

Perhaps the greatest criticism is the poor bodies often used by the art potters. They generally are soft, porous, and of low strength. Such bodies are not used by choice but are due to the temperature limitations of most of their kilns as well as to lack of knowledge of body compositions. Even where good whiteware bodies are used, the pieces are apt to seep because glaze fit has had to be sacrificed for color or texture. Low-temperature vitrified bodies, which will hold their shape in the kiln, have not been successful. Some of the newer body materials offer possibilities of reduction of maturing temperatures to a point within the limits of present kilns.

VI. Market for Craft Pottery

The art potter has had an uphill struggle in finding sufficient outlets for his work. During the depression years it was difficult, and many potters turned to teaching in schools, camps, and private classes. This resulted in many more people becoming interested in pottery making, and it broadened the market for the craftsman's work.

The main marketing difficulty has been in reaching the right type of customer. Some potters in favorable locations have been able to sell almost their entire output locally, but many of them must market their work away from home. There are adequate merchandizing organizations to handle all types of volume products, but craftsmen do not have volume sufficient to be profitable to this type of merchandizing. These craft potters literally have to "peddle" their ware to the gift shops, specialty shops, department stores, and galleries.

The execution of special orders offers another field for the art potter. Many stores have ideas of their own which they wish executed, but usually the quantity wanted does not interest the production plant.

Mail order sales are suggested as means of reaching the right type of customer. This method has little chance of success unless good color printing is used. Color and texture, which can not be shown in black and white, is far ahead of form in the appeal of pottery. So far, good color work is too expensive for the small volume to be sold.

All of these sales problems lead to the thought of some sort of coöperative selling organization which could collectively offer a sufficient volume of individual work to afford showrooms and salesmen. In this way the potter would not lose his individuality, and a greater variety could be secured more easily by buyers.

Art critics have said that while these American art potters have mastered the various techniques and achievements of the ancient masters, they have not evolved anything new or distinct. If this is true, the future is most promising for American ceramic art. Surely, when these potters will have captured the feeling and form, the beauty of color, and the texture of the Chinese, Egyptian, and Persian potters, they will produce a ceramic art of merit and distinctiveness sufficient to endure and be known as typically American ceramic art.

ROCK TAVERN, NEW YORK

COMMUNICATIONS—CERAMIC HISTORY

FRANK JEROME TONE

Tone, Frank Jerome, pres. Carborundum Co.; b. Bergen, N. Y., Oct. 16, 1868; s. Thomas J. and Catherine (Spafford) T.; M.E., Cornell U., 1891; m. Gertrude Franchot, of Niagara Falls, N. Y., June 28, 1900; children: Frank Jerome, Franchot. Engr. with Thomson-Houston Electric Co., Lynn, Mass., 1891–1893; Pittsburgh Traction Co., 1893–1895; works mgr. Carborundum Co., Niagara Falls, 1895–1919, pres. since 1919; pres. Canadian Carborundum Co., Ltd.; dir. Power City Bank, Bernitz Furnace Appliance Co. Mem. Am. Ceram. Soc., Am. Electrochem. Soc., Am. Inst. Chem. Engrs., Am. Chem. Soc., A.I.M.M.E., Soc. Chem. Industry (London), Phi Kappa Psi. Republican; Presbyn; Clubs: Niagara, Rotary, Niagara Falls Country; Chemists' (New York). Originated first commercial process for production of silicon metal; discovered silicon monoxide, fibrous silicon oxycarbide, silicon carbide heating elements, and other high temperature products of silicon. Awarded Medals: Paris Expn., 1900; Pan Am. Expn., Buffalo, 1901; St. Louis Expn., 1904; Jacob F. Schoellkopf Medal by Am. Chem. Soc., 1931; Edward Goodrich Acheson Medal by Electrochem. Soc., 1935; awarded honorary degree of Doctor of Science by the University of Pittsburgh, Pa., 1935; Perkin Medal by Amer. Section of Society of Chemical Industry, 1938. Home: 131 Buffalo Avenue. Address: The Carborundum Company, Niagara Falls, N. Y.

Summary of Achievements

Originator first commercial process for the production of silicon metal; discoverer silicon monoxide, fibrous silicon oxycarbide, electric furnace mullite and spinel; achievements in the commercial development of synthetic abrasives and refractories, particularly silicon carbide, also silicon carbide resistor elements.

Achievements of Frank J. Tone

Dr. Tone holds the unique distinction of being the only man now living to discover a method of producing a common element in such a manner that it might be utilized industrially, and he has also played the key part in building up from humble beginnings two major industries (synthetic abrasive and refractories), which, although related, are widely divergent in their manufacturing practice and fields of application. Outstanding among the numerous developments for which he has been responsible was his achievement, early in the present century, of producing the element, silicon, in unlimited quantities and at a price that permitted its industrial utilization. Heretofore this element had been a laboratory curiosity, despite the widespread occurrence of its compounds. This accomplishment must still be regarded as one of the major scientific feats of modern metallurgical chemistry.

It is interesting to note that Mr. Acheson engaged the services of Dr. Tone in the early nineties, and it was the

latter who played a major part in carrying Dr. Acheson's invention of silicon carbide to a commercial success. A remarkable ability to recognize future possibilities was shown by Dr. Tone at his first meeting with Dr. Acheson, and the courage of his convictions was evidenced by his accepting this new position at only half the salary he was then receiving.

When Dr. Tone came to Niagara Falls in 1895, he became one of the pioneers in the development of electric furnaces on a large scale. The buildings of the newly formed Carborundum Company had been erected, but were substantially empty and had lain idle several months. Furnaces and machinery had to be devised and put into operation. He and his co-worker, F. A. J. Fitz Gerald, were the first to apply a thousand horse-power to an electrothermic process and were soon utilizing in this manner about half of the entire output of Niagara Falls power. He distinguished himself at that early date by his ability to handle the furnaces at elevated temperatures and to convert even the mishaps (that are natural in a new art) into discoveries of new possibilities. The most important of these were the production of electrically fused aluminum silicate and silicon metal. Many of the present-day theories of the high temperature reactions of silica are based directly upon his observations in those early days.

Dr. Tone's part in the great task of replacing natural abrasives with the more dependable, chemically inert, synthetic materials which could be more satisfactorily bonded and more effectively utilized, and of introducing and advancing the application of abrasives in fields previously undreamed of is an accomplishment that shows not only ingenuity and patience, but also his broad vision and ability to use to best advantage the discoveries he had made. His endeavors involved an intensive study of the properties of abrasives and related materials made in the electric furnace, particularly silicon carbide, as well as the development of chemical and engineering processes for handling, purifying, and bonding these materials, and the extension of abrasive uses into new fields. He was, for instance, the first to grind wood commercially with synthetic abrasive wheels, thus laying the foundation for what has become an important phase of the pulp grinding industry.

Paralleling his achievements with electric furnace products in the abrasive field, Dr. Tone is primarily responsible for the present development of the synthetic refractories industry. He first foresaw that, compared with specialized refractories service, price was a secondary matter, and he introduced refractory brick at a dollar apiece where others competed for business at five cents. His vision and persistence in this field, in the face of the doubts of his associates and frequent unsuccessful trials, were the largest factors in building the refractories division of his Company from its early stage of scientific speculation to its present proportions as a sound commercial enterprise. This refractories division utilizes thousands of tons of silicon carbide in a single year and provides the numerous industries whose production depends on heat-resisting and heat-conducting materials, with silicon carbide refractories that have far greater heat resistance and ten times the conductivity of the fireclay material previously used. In addition, he devised many special applications of his new refractories, such as silicon carbide water-walls for boiler furnaces, which are today in some of the country's leading central power stations, permitting higher boiler ratings and lower cost power to the consumer.

The production of mullite and spinel in the electric furnace constitutes two more important contributions that Dr. Tone has made.

Dr. Tone's ability as an executive has been demonstrated over a long period of years. He served as works manager of the Carborundum Company from 1895 to 1919 and then as its president from 1919 to the present time. In addition, he has been active in fields removed from the abrasive and refractory industries for he was also president of Globar Corporation, an officer of various other companies, and former president of the Republic Carbon Company.

It is noteworthy that Dr. Tone's duties as an executive have not interfered with his productivity along inventive lines. This is attested by the fact that 156 patents have been granted to him in a period ranging from 1902 to 1937, in addition to which a number of others are still pending in the United States and foreign patent offices.

A bibliography of the articles he has published is attached hereto, showing that his interest in the field of applied chemistry has included a desire to give others the benefit of his experience by making public his discoveries along various lines. This broad interest in many subjects pertaining to applied chemistry is attested to by the fact that Dr. Tone is a member and Fellow of the American Ceramic Society, joining in 1906; the American Chemical Society, the American Institute of Chemical Engineers, and the American Electrochemical Society (president, 1918–1919).

Recognition of his achievements has not been confined to his own company. Recent tributes to his accomplishments came in the form of the award of the Jacob F. Schoellkopf Medal by the Western New York Chapter of the American Chemical Society in 1931 of which he was the first to receive the award; the Edward Goodrich Acheson Medal awarded by the American Electrochemical Society in 1935; honorary degree of Doctor of Science from the University of Pittsburgh in 1935; and the Perkin Medal by the American Section of the Society of Chemical Industry in 1938.

Dr. Tone's contributions to the advancement of science, however, are not to be measured only in the fields in which he has directly labored. Their effect has been felt throughout the numerous industries (such as the automotive trade) that depend for their success upon the highly satisfactory abrasives that are now obtainable and throughout those other industries in which the efficiency of the synthetic refractories utilized is an all-important element. It is in these industries that America leads the world today, and this leadership must be laid in large part to those developments which have resulted from the keen insight, inventive genius, and business acumen of Frank J. Tone.

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SOME RECENT DEVELOPMENTS IN AMERICAN GLASS MANUFACTURE: II, 1931 TO 1938*

By Alexander Silverman†

I. Introduction

In 1930, the author presented a paper of this same title at the Congress of Industrial Chemistry in Liége, Belgium.[1] As numerous important developments have been made since, in America, the presentation of another paper on the subject seems justifiable. The present paper will confine itself largely to products, and little attention will be given to mechanical devices.

II. Plate Glass

The processes for individual casting and continuous production of plate glass are substantially the same as they were, except for mechanical improvements which involve a higher order of scientific precision. With the advent of multiple glazing involving two, three, or even four plates with air spaces between, a more stable, water-white glass was desirable. By increasing the potash content, minimizing the iron, and adjusting the batch composition, a nonblooming variety resulted. This is employed in the manufacture of refrigerators and in special building units. The range of colors in plate glass has been extended both in transparent and opaque varieties, which are now employed in architecture. Pale blue and flesh-tint plate are among the popular colors in the transparent type.

The *Profilograph*, which makes a study of the contour of the ground and polished surface, has resulted in improved practice for grinding and polishing. This instrument records a vertical magnification of 5000 and a horizontal magnification of 450. Minute irregularities are, therefore, magnified to a point where they are easily perceptible in records. Another instrument known as the *polish meter* indicates total reflection from the surface and evaluates polishing methods and materials.

Laminated plate glass, while not new in principle, has been improved from the standpoint of the plastic binder. It was formerly necessary to seal the edges of laminated plates to prevent atmospheric attack upon the plastic. With the newer incompletely polymerized vinyl resins, this is no longer necessary. They are not only stable when exposed to atmospheric agencies, but are practically unaffected by light. They are more resistant to heat and, because of their flexibility and mechanical strength, the safety factor in case of accident is better than with the older glasses. Their relative breaking strength is much greater than that of cellulose nitrate and some other adhesives that were formerly employed. An ingenious method has been devised by one company for bending two plates of glass so that their contact surfaces will coincide within about $^1/_{25}$ inch to permit the introduction of the plastic sheet. Laminated glass is therefore available where curved units are required and where the safety factor is important.

Tempered plate is also being manufactured fairly extensively. For its production, the oil-immersion or air-cooling principles are applied. While laminated glass is still preferred for automobiles, especially in wind shields, the tempered plate has been employed for side and rear windows and in laminated form for the wind shields. In the latter, fracture resulting in many thousands of tiny fragments which adhere to the plastic binder naturally obscure the vision. Tempered plate glass, however, is being employed in building construction, in the production of all-glass swinging doors, to which the hinges and other metal parts are clamped, and, to some extent, in the building of aquaria, in some of which plates as large as 48 by 108 inches have been installed. It is interesting to note that plate glass is bent into various shapes and subsequently tempered. In this form, it is used for household furnishings, such as end tables and other all-glass furniture.

III. Mirrors

The bright silver mirror on the underside of the plate is being produced more extensively than ever. Its application has been extended to transparent colored glasses, especially the light tints which are employed architecturally. All of these are naturally backed by protective coatings. A newer development includes the so-called *transparent mirror*. It is well known that thin films of metals possess color by transmitted light; in the case of silver, this is blue. By depositing a perfect, thin film, which is transparent, not backed and coated, and covering with a second plate of glass for protection, a product results which is employed in advertising devices. A light shining upon an individual in front of this mirror makes it a looking glass. Just as he begins to admire himself, the outer light goes off and an internal illuminated sign advertises a commodity. The transparent mirror also offers possibilities in hospitals, especially for observing nervous patients who fret in the presence of an attendant, but who can be watched from a dark adjoining room through the transparent mirror. One American automobile manufacturer is said to have produced several hundred motor cars with transparent-mirror window panes. In such a car the occupants can observe the surroundings without themselves being seen.

Silver mirrors, as stated, are on the far side of the glass and, as most plate glass has a greenish tint, the reflected image is not perfect as to color. In recent developments, especially for optical purposes, *aluminum* or an aluminum-magnesium alloy has been placed in a tungsten trough which is electrically heated in a vacuum chamber. A cold plate of glass suspended above the vapor becomes coated on the near side with a metal film, whose very thin and superficial surface oxidation protects it. The reflection of various colors in the visible spectrum by aluminum is superior to silver and, in addition, the mirror is not behind the glass. This type of mirror may not come into general use, but it is interesting for its true color portrayal of the object, which is viewed therein or reflected thereby in optical instruments.

IV. Window Glass

In this field, the hand-cylinder and Lubbers' mechanical process have practically disappeared in America. The Fourcault process for vertical drawing and Colburn process for horizontal production are in general use. The improvement of the former through the introduction of temperature controlling units in the molten glass and during the drawing and the mechanical improvement of both processes through the introduction of various types of rustproof metal rollers have resulted in a window glass which has a remarkably regular surface. A study of batch composition and refining agents now yields glasses which are practically free from seeds and striae. In some cases, the window glass is so nearly perfect that it is laminated for automobile use.

V. Bottles and Bulbs

Improvements in this field are largely mechanical. Various types of automatic machines of the suction and feeder type are in use for bottle production. Increasing efficiency in the production of a single type of bottle has

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[1]Alexander Silverman, "Quelques Récents Perfectionnements dans la Fabrication du Verre en Amérique," *Chimie & industrie* (France), **25**, 367 (1931).

yielded as many as a million and a quarter beer bottles per 24 hours in one American factory. The ribbon-type continuous production of lamp bulbs, which was discussed in the 1930 paper, results in a million lamp bulbs per day in a single American plant which employs two of these machines. The American production of lamp bulbs is now up to about three million per day. Improvements in lamp bulbs have resulted largely through the type of construction and subsequent treatment of the glass bulb itself, after manufacture of the glass unit.

VI. Pressed Ware

Here the strides have been enormous, not only in the production of novelties and tableware, but especially in the manufacture of building blocks or hollow glass tile. While hollow tile has been in use for more than fifty years, its extensive production is something new. The halves are pressed from ordinary lime glass or heat-resisting glass, as the case may be, and the two halves are sealed together in such a way as to destroy clear visibility through the assembled unit. In one process, the halves are sealed together by dipping into molten aluminum; in a second, the glass edges are sealed through the use of a blow torch; in the most recent process, the halves are joined together directly during the pressing process without a prolonged accessory treatment. Building construction involving the use of this hollow glass tile is constantly increasing. Corrugations and prisms have given way to irregular waves in the most recent diffusing type. Instead of rectangular or square faces, one design includes hexagonal faces. Tile is being produced in transparent greenish or colorless glass, and there seems to be hope for the early appearance of alabaster, opal, and colored blocks.

In the *lighting field*, the production of opal bowls for direct, semi-indirect, and indirect lighting must now meet a great variety of specifications. In a few cases, very opaque glasses have been produced directly and in others the opacity has been increased through thermal treatment which encourages the growth of crystallites. In one instance, the pressing process itself shows marked improvement. Instead of using a mold and plunger equipped with a ring, the glass is placed in a receptacle and the plunger, through careful thermal control, causes the glass to flow uniformly outwardly in all directions. This results in a bowl which has a rounded edge and does not show the line of demarcation of a ring.

Mention might be made also of the mechanical production of *glass marbles* of inconceivably perfect spherical contour. This is quite remarkable when one considers the variety of colored glasses which are mixed together in their production.

Pressed window plates and *tile* of prism and other design as well as the rolled prism type might be mentioned here, though they could, in part, have been included under plate glass. Glass tile is produced in a variety of shapes and colors. One new prism type results in practically total reflection; another in a dense cream opal glass has been used for the ceiling of the new Mid-Town Tunnel in New York City. Tile of the latter variety is so designed that it is held perfectly and securely by a resilient cement which has sufficient play to take care of the shrinkage and expansion of the glass with variations in temperature.

Pressed glass curved plates or roofing tile, plain and tempered, should be included among the newer products. These overlap and interlock in such a way as to produce a continuous glass effect. Reinforced shingles are also employed.

VII. Cellular Glass

Cellular glass has been employed for a good many years for filters in chemical laboratories, but its application to the making of brick and tile for insulating purposes is comparatively new. In one European process, the pulverized glass is mixed with coal and heated in molds. This results in a lightweight, porous brick which is gray in color. An American improvement upon this process has resulted from the use of a vaporizing agent which does not discolor the glass. The product is snow white. It can be made in various degrees of porosity and density. To be specific, one type weighs 33 lb. per cu. ft., has a modulus of rupture of 400 lb. to the sq. in., a compression strength of 600 lb., and an index of thermal conductivity of 1.2 B.t.u. The heat insulation depends on air in the cells. The bubble glass can be made as light as 13 lb. to the cu. ft., with a thermal insulating value of 0.6 B.t.u. per sq. ft. of 1-in. material. It is not as good as glass wool, whose value is 0.266 B.t.u., but it possesses other advantages over glass wool. The American cellular glass has been made in tile of various thicknesses, which have been glazed in colors. By using a variety of colors in squares approximating 4 or 5 inches in diameter or by using a variety of shapes, attractive color schemes can be obtained for building exteriors or interiors. They may be covered by transparent plate glass. Buildings which are insulated with cellular glass are more sanitary than ordinary structures, for it prevents the entrance of rodents and vermin through walls. In addition, cellular glass is nonflammable and possesses this advantage over cork-brick and other flammable structural insulating materials. There is no internal condensation of moisture as in glass wool.

VIII. Fiber Glass

This is unquestionably the most startling development of the past decade. From the small-scale production of glass wool for laboratory use, a vast industry has arisen. Subjecting molten glass marbles or a continuous stream of molten glass to a steam jet, the glass is blown through tiny orifices into minute fibers. A vacuum system gathers these filaments which average several inches in length into a glass wadding which has varied uses. For *thermal insulation* a 4-in. layer is equivalent to a 10-ft. concrete wall. Like cellular glass, it protects against rodents and vermin and is nonflammable. Treated with a sticky adhesive, it is used as a dust filter in *air-conditioning* systems. It has been employed in *agriculture* as strips which are tied around trees to prevent the ascent of insects, and their consequent destruction of foliage; also, in sheets for covering beds as a protection against frost and cold which otherwise would penetrate the soil.

Glass filaments averaging about 1 ft. long are twisted and woven into *yarn* of various types. By careful process control, the filament length can be increased and in one instance, purely to satisfy curiosity, a single marble was drawn into a filament 300 miles long. From the yarn, *glass ribbon* is produced which serves as an insulator in electrical equipment and woven glass tubing for insulating wire. Glass *fabrics* of various types and designs have been created. Some are manufactured for electrical insulation in large machinery and others as plate separators in storage batteries. Fabrics vary from an extremely open cloth for *motion picture screens*, involving sound reproduction, to extremely heavy cloth which is used for filtering chemicals. The immediate uses of glass cloth will probably be limited to electrical insulation, the compressed or woven *filter cloth*, the motion picture screen, and possibly nonflammable awnings or sun-shades for outdoor use. The nonflammable character of the last-named would prevent fires which frequently result from throwing lighted cigarettes out of the upper windows of buildings. It is interesting to note that beautiful designs have been produced in glass fabrics, such as patterns found in linen table cloths and in fancy silks and satins, including brocades. Curtains and drapes have been made. They present a striking appearance. The yarns have even been crocheted and knitted into neck ties, hats, and garments. One must, however, be careful before adopting glass cloth and garments for *wearing apparel*. Despite its flexibility and strength, a glass filament will break. If the tiny splinters have a sufficient diameter, they prick the skin and produce an unpleasant itch. One speaker recently went so far as to say that a new unit of tolerance had been established. It is called an *Itchibell* and refers to fibers which are 0.0003 inch or more in diameter. This speaker recommended that not more than three Itchibells per 10,000 be present in yarns that are used for making wearing apparel. We

must also ponder over the possible effects even of the smaller fragments which might float through the air much like colloidal dust particles. What effect will they have on the respiratory tract? Will they irritate the eyes? These are questions which should be given careful thought before glass is adopted for wearing apparel, or even for use in the home for drapes, hangings, furniture coverings, etc. In fact, these questions might be considered with reference to the future when old buildings in which glass wool is used for insulating purposes must be torn down and replaced. Though a lover of glass, your speaker can not avoid these thoughts.

To the writer's knowledge little or nothing has been done in America as yet to utilize spun glass for *light diffusion* or in the production of *art windows* where colored fibers are employed. One can not overlook the interesting and fascinating applications of these principles in Italy.

In closing the section on fiber glass, it might be interesting to include some of the properties. The diameter of glass fiber is about $^1/_{10}$ to $^1/_{15}$ that of the human hair. In insulating fibers, it averages 0.0004 in. and for textile fibers usually less than 0.0003-in. The tensile strength of a filament of 0.0003 in. diameter is 120,000 lb. per sq. in., about double that of soft steel and a little less than one-third as great as piano wire. Depending on their composition, the fibers in glass wool and filtering cloth are stable against one chemical or another. In glass batting, the moisture absorption was less than 0.05 lb. per cu. ft. after 240 hours' exposure in an atmosphere of 100% humidity. Because of the smooth surface of filaments, glass wool has a low resistance to the flow of gases and liquids. This is natural for it weighs only 1.5 lb. per cu. ft. It is not only rodent- and vermin-proof, and nonflammable, but unlike organic materials, it is not subject to rotting, fungus, and bacterial action and is a nonabsorbent of odors. It has the further property of absorbing sound, as it dissipates the sound waves. Because of its elasticity, it does not settle readily under vibration and jolting. While the abrasion test for glass yarns is much lower than for cotton yarns, the lack of necessity for frequent laundering or rubbing should make this a negligible factor. For electrical resistivity, glass fabrics and wool depend on the air cells. To increase this resistivity, one can impregnate them with oils or resins.

IX. Optical Glass

The most striking contribution to this field in recent years was the production of the *200-inch casting* of a low expanding glass for use as a telescope reflector in the Palomar Observatory in California. The first casting was discarded, but the second, which was prepared in a porcelain mold, was pronounced satisfactory. It was not only transported safely across the American continent, but is now in the process of grinding and polishing. Through the use of the 200-inch reflector, the magnification of heavenly bodies observed will be so great that the moon will have the appearance which it would to the naked eye if only 25 miles from the earth. Astronomers anticipate that other gallaxies, beyond those now visible, will be available for study.

A large number of glasses for the *transmission* or *absorption of certain radiations* have been added to the American list. The somewhat older types as well as the newer phosphate glasses include the transmission of the ultra-violet from violet-ray generators and in windows; they are colorless glasses which also transmit the regular visible radiations. The heat-absorbing glasses include plate and window glass of various types, as well as special glasses for use in optical instruments like motion-picture projectors for the absorption of heat rays and protection of film. The latter filters possess comparatively little color. Many of the heat-absorbing glasses transmit less than 30% of solar heat radiation. One radiation-absorbing glass which deserves special mention is a high-lead glass colored yellow with uranium. This plate glass effectively protects X-ray operators.

In the regular optical glass field, one company is producing a barium *crown* of refractive index 1.616 and a reciprocal relative dispersion of about 50. This glass is highly resistant to atmospheric attack and acidic corrosion, and therefore differs from most barium crowns. The glass works successfully with a number of others which must be employed in making bifocal lenses; it can also be combined with colored optical glasses which absorb certain radiations. Another development is a flint glass of index 1.70 for use in bifocals. This also is resistant to atmospheric corrosion. Considerable work has been done in the United States on *tempered glass* for use in spectacle lenses. These blanks are provided regularly by several companies, and it is said that they can be ground to prescribed curvature without shattering.

New *eye protective devices* include laminated glasses, not only for ordinary lens combinations, but for special absorbing systems. One important lens contains *polaroid* in the binder and prevents glare. This has advantages in motoring and aviation. In a few instances, laminated glasses containing polaroid have actually been ground to correct visual abnormalities. While they are extremely expensive, as yet, there is a possibility that they may become a regular commodity in time.

Polaroid has created a great stir in this country. It is employed extensively in various instruments for strain determination. One even has the advantage of setting up a comparatively simple method of strain-finding by wearing a pair of ordinary polaroid goggles which are not expensive and placing the object to be examined between a polaroid plate and the goggles. It is possible not only to demonstrate stressed double refraction, but by the use of stepped radiation plates to demonstrate interference colors and make approximate quantitative measurements of strains. The polaroid, protected by layers of glass on either side, has been used in *photography*. When motion pictures are taken with a polaroid disk appropriately inserted in the lens system, the theater-goer can see the picture in three dimensions, if he in turn wears polaroid goggles. This will probably establish a new departure in the motion-picture field in the near future. With the advent of natural color films and three dimensional projection, the ordinary black and white film though less expensive will undoubtedly in time be relegated to classical history in photography.

While not belonging to the glass field, mention might be made of the production of *large crystals* of lithium fluoride (up to 4 in. in diameter and 5 in. long) and potassium bromide (up to 3 in. in diameter). Lithium fluoride serves as a substitute for fluorite and is available in larger crystals than the former. It can be used for studying the Shumann region of the *spectrum* and substituted for quartz in the *short-wave* end. It can be employed for quartz-lithium fluoride achromatic lenses. It is available in blanks for windows, prisms, or lenses which are cut to specifications. The potassium bromide serves as a substitute for natural Halite for infra-red spectroscopy, and one can go farther into the infra-red than with Halite.

X. Chemical and Thermal Resistance

Low-expanding, shock-resisting glasses have been improved for laboratory use and their use has been extended to the household not merely as cooking ware, but for stove tops, oven windows, etc. Other special glasses which are resistant to sodium vapor have been developed for use in the new *sodium vapor lamps*. Still other treatment has been given to the inner surface of glass tubes and bulbs to insure *greater luminosity* where light sources are rich in ultra-violet and where a secondary visible radiation is induced in the treated surface.

XI. Enamels and Stains

While appreciable strides have been made in the production of new frits and colors for enameling and decorating glasses, special mention should be made of the chemically resistant transparent colors which are now applied to *calibrated glassware* for laboratory use.

XII. Art

Here constant advancement has been made in design and decoration in the American industry. Outstanding

among the art developments are the massive cast glass panels in Rockefeller Center, New York, and the mosaics in the Union Station, Cincinnati. There are also frequent examples of unusually fine engraving, cutting, etching, and sandblasting. The last two are now applied extensively to mirrors and wall panels. A promising process is under way for producing half-tone etchings on glass from photographs and paintings. These, plain, in color, or backed by a mirror, are most attractive. Glasses, which were at one time confined to European factories, are now made and employed in the production of American artware. This is true especially of the opal and colored glasses.

XIII. Chemicals

Added to the list of minerals formerly available are nepheline syenite and kyanite, the latter especially treated for use in glass manufacture to insure a low iron content. Synthetic niter has replaced the refined South American products. The synthetic material lacks certain minute impurities which the refined mineral contained and which served as catalysts. Some of these are reintroduced into the glass batch with the pure niter. Realizing the influence of water in glassmelting, a number of chemical manufacturers have placed anhydrous materials on the market. These include calcined pearl ash, borax, and alumina.

XIV. Refractories

With the advent of special glasses which have a tendency to attack or corrode refractories, studies have led to the production of special pots and tank blocks for such use. The composition of the refractory has been modified to suit the particular requirement and the heat treatment given also varies with the use. Some refractories are even prepared at very high temperatures in electric furnaces. Density has been increased and the smoothness improved to insure greater resistance to corrosion. Kyanite-type blocks seem superior for the upper structure of tanks because of their resistance to alkali attack. A study of checker and port brick has been made to lower attack by alkalis and fluorine compounds. Semipermeable muffles and linings as well as tubes have been introduced into annealing and decorating leers and kilns. They involve the surface combustion principle in gas firing.

XV. Mechanical Accessories

With the knowledge that dust is a serious contaminant in the plant, air-tight mixers of various designs have been introduced. Air filters have even been proposed to insure further against dust. Automatic weighing machinery with *dust-preventing devices* is another promising development, and mechanically operated screens to insure uniform grain size of raw materials may be equipped with partial vacuum devices.

Special alloys for molds, pipes, and other accessories have become available. Some of these are high carbon, high silicon types, while others are of the rustproof chromium-nickel variety. *Cutting tools* equipped with tungsten carbide edges are coming into greater use. Shorter *casting tables* have become available, which replace the large, heavy, and expensive tables formerly employed for rolling glass with designs. They have also been applied to plain rolled sheet. They are said to produce remarkably smooth surfaces and can even be used for sheets 48 in. wide and 10 ft. long, producing as many as 42 sheets per hour in $^1/_8$ in. thickness, and about half that quantity in $^1/_4$ in. Other machines have been perfected for bevelling plate glass for mirrors. Screen, link, and chain *conveyers* of considerable variety have become available. According to the type, they permit a greater or lesser circulation of air in annealing ovens.

Modifications in *furnace designs* are too numerous to include. They involve the melting end in nonthroat and throat-type units and, by a control of convection currents, melting time has been reduced. Suitable construction has lessened the tendency of glass to freeze to the blocks at the bottom of the tank. Stone formation has been minimized, and in some cases it has actually been possible to operate at temperatures as high as 2900°F with yields of 140 tons per day of good quality glass. The reversing regenerative furnace has given way in certain plants to a nonreversing recuperative furnace with a double crown. The controlled flow of air currents has insured success.

In addition to highly efficient bulb and bottle machines which have already been considered, press and blow machines are now available in which a variety of ware can be produced on a single machine, either by using several types of molds at one time or using a single type which is interchangeable with other types. One of the most interesting of the newer machines is an 8-mold press for the production of building blocks.

XVI. Patents

Since 1930, the United States Patent Office has issued more than 1700 patents covering furnaces, machinery, composition, design, etc., in the glass field. It is encouraging to note that America is forging to the front not only from the standpoint of mechanical equipment, but also in glass composition and properties and in improved design of the ware.

Acknowledgment

A report such as this would have been impossible without the coöperation of other individuals and companies. The writer is greatly obligated to American manufacturers for their generous response.

Head, Department of Chemistry
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PRESIDENT'S COLUMN

AMERICAN CERAMIC SOCIETY HEADQUARTERS

The growth of the American Ceramic Society, its increasing usefulness, its breadth of vision, its contributions to American ceramics in general, and its importance argue for the establishment of new and commensurate headquarters.

This refers specifically to a suitable building in which to provide adequate facilities for the safe keeping of the Society's publications, its library, and the excellent exhibits of ceramic products secured by Dr. Purdy and to provide modern and comfortable offices for the general secretary and his staff.

A new home for the American Ceramic Society would add immeasurably to the prestige of the Society. It would elevate the general concept of the usefulness of our organization.

The valuable ceramic reference library and museum of American ceramics require suitable housing facilities. If our members could see the library and the excellent specimens of American ceramics, there would unquestionably be a strong desire to foster the movement for a new office building. The library and museum, now of great importance and value, represent an excellent start, both of which should be increased from time to time.

The matter of building a new home for the Society or a new office building is one that has been discussed, but altogether too casually. Time for action has arrived.

There is some way to finance this program. A Building Committee has been appointed, and this Committee will be glad to receive suggestions with respect to ways and means of financing this project.

It seems almost unnecessary to present arguments for the purpose of selling this idea to the members of the American Ceramic Society. The reason for this is that the necessity for suitable quarters is obvious. It appears that one requirement at this time is to suggest for the information of all members the necessity for an office building to be owned by the Society and to say that a great many ceramic manufacturers would no doubt be willing to sell their products at cost for use in the construction and the furnishing of the building.

Many members have already expressed a desire to contribute to the financing of this proposal. It is generally agreed that, over a period of fifteen years more or less, the building could be underwritten through contributions by the members. This plan would not be a burden to anyone.

Someone or perhaps many who read this appeal may be able to develop a unique and practical method outlining ways and means for the purpose of providing adequate funds. Your ideas will be appreciated, and it is hoped you will direct them to the Society's headquarters in Columbus. What are your ideas?

—Victor V. Kelsey

NECROLOGY

JOHN HOWELL GRIFFITH

John Howell Griffith, Research Engineer of the Iowa State College Engineering Experiment Station, died July 14, in Ames, Iowa. Death was caused by disease of the heart.

J. H. Griffith

Professor Griffith, while never a member of the American Ceramic Society, had contributed papers on the subject of strength of structural clay products to the Society's publications, and in his bulletins devoted considerable attention to similar study.

He had served on the Bureau of Standards staff when that institution was located at Pittsburgh and had been on friendly terms with many of the ceramic experts of that staff. His interests in ceramics had developed because of those contacts.

Professor Griffith was born in Syracuse, New York, and had his graduate work at the University of Wisconsin. He was of the teaching staff of the University of Michigan and other institutions in Civil Engineering, and he was gifted in ability in design of steel structures.

At the time of his death, he had started work on a project dealing with the hardness of glazes, engobes, glasses, and enamels and had his apparatus ready for data taking. His choice of this project resulted from his interest in the objectives of the American Ceramic Society and his warm friendships for many men of the Society.

JOHN A. CAMPBELL

John A. Campbell, chairman of the Board of Directors, Trenton Potteries Co., Trenton, N. J., and widely known throughout the ceramic industries, died at his home, June 3, 1938, at the age of eighty-two. He had been confined to his home for about two weeks following a heart attack.

Mr. Campbell was born at Shushan, N. Y., and was graduated from the Collegiate Institute in New York in 1873, and from Princeton University in 1877. He received an honorary degree from Princeton in 1907. After leaving Princeton, Mr. Campbell went to New York City to engage in the pottery importing business. He remained there until 1879, when he came to Trenton to become connected with the International Pottery Co. With this company, he was associated with his former classmate at Princeton, the late William Burgess, with whom he had engaged in pottery jobbing in New York. The two men turned their attention to Trenton as a prospective business field when they found it difficult to obtain regular shipment of goods from England. Trenton at that time was known as "the Staffordshire of America."

John Moses, owner of the International Pottery, offered to sell a half interest in the plant to the two young men. The offer was accepted, and later the youthful partners purchased the remainder of the business from English holders. Mr. Campbell became treasurer of International, retaining that position until 1906, when he was made general manager of Trenton Potteries Co. Under Mr. Campbell's leadership, the latter company developed into one of the most important pottery organizations in the country and absorbed several smaller Trenton plants. He was made head of the firm in 1910. In 1924, the Crane Company of Chicago purchased control of the Trenton Potteries Company and its subsidiaries; Mr. Campbell remained as president and occupied that position for a period of twenty-two years in all. In 1932, he became chairman of the Board of Directors, continuing in that post until his death.

John A. Campbell

The Trenton Banking Company elected Mr. Campbell a director in 1897, and three years later made him vice-president, a newly created post. From 1904 to 1927, Mr. Campbell was president of the bank, resigning in the latter year to be relieved of the responsibility of the office.

Mr. Campbell was active in civic affairs in Trenton throughout his life and gave freely of his time in any worthy

movement for the benefit of the community. In 1910, he was appointed to the board of trustees of the School of Industrial Arts, and for many years served as president. When the trustees of the Trenton Public Library were appointed in 1900, Mr. Campbell was made a member of the board. He served as library treasurer until 1910, when he succeeded the late Ferdinand W. Roebling, Sr., as president. For 15 years he was president of the New Jersey State Board of Tenement House Supervision. Mr. Campbell was interested in the Y.M.C.A.; he served on its board and, at one time, as its president. He also was a loyal supporter of the Boy Scout movement and was prominent in church and club activities.

JOHN MADDOCK*

John Maddock, Trenton, N. J., widely known manufacturer of sanitary ware for many years, died May 28, 1938, at his home, at the age of ninety. Until his retirement from active business about 12 years ago, Mr. Maddock was president and treasurer of the former John Maddock & Sons Co., Trenton, one of the largest sanitary potteries in the country.

Mr. Maddock was born in New York, February 5, 1848, and was educated in the public schools of that city. Then he engaged for about four years in the stationery business at Jersey City, N. J. He abandoned this business to go to Trenton to engage in pottery manufacture with his father and three brothers; he later branched out, with his sons, in his own business. One of the best-known pottery manufacturers in the country, Mr. Maddock was one of early Trenton's outstanding business men and citizens, who helped materially in establishing this city as the one-time pottery center of the east. With his retirement in 1926, the John Maddock & Sons Company, which he founded in 1895 with his four sons, was closed. The plant, during its many years of operation, had been recognized as one of the largest sanitary potteries in the country.

Prior to 1895, Mr. Maddock was also associated in the pottery business in Trenton with his father, the late Thomas Maddock, and his three brothers, the firm name then being known as Thomas Maddock & Sons.

* For a history of the Thomas Maddock Sons Company and a genealogical chart of the Maddock family, see *Bull. Amer. Ceram. Soc.*, **16** [9] 385–86 (1937).

CHARLES N. BRADY*

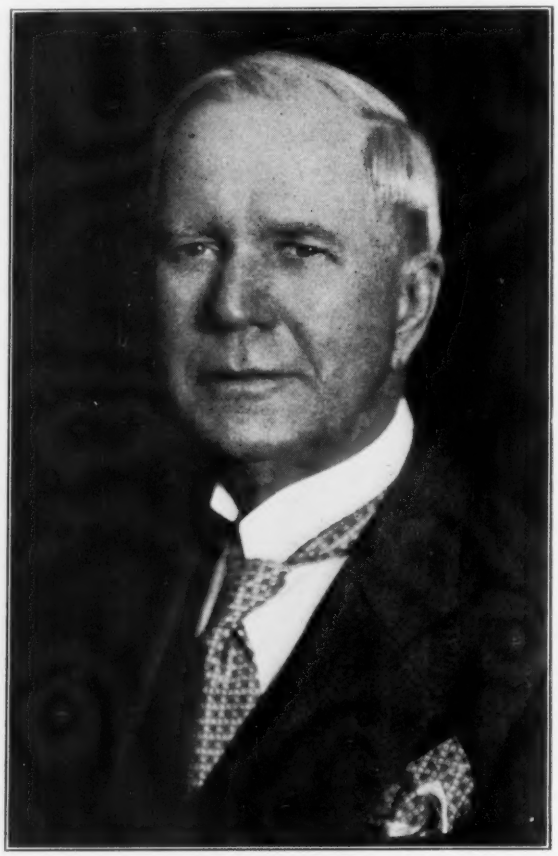
Mr. Brady, Washington, Pa., one of the founders and first president of the Hazel-Atlas Glass Co., Wheeling, W. Va., died at his home in the first mentioned city, July 6, aged 89 years. Following early years in various lines of occupation, Mr. Brady in 1879 joined a coöperative company then being formed to manufacture table glassware, known as the Riverside Glass Works, to operate at Wellsburg, W. Va. Later, in 1886, he organized the Hazel Glass Co., with Charles H. Tallman, secretary of the Bellaire Stamping Co., with offices at the same place. In the year following, the plant was moved to Washington, Pa., where gas for fuel was economical. In May, 1889, the company was chartered under Pennsylvania laws, with the same name. Later, the Atlas Glass Co. was formed by Mr. Brady and several associates, and subsequently the two companies were merged. Mr. Brady was widely known throughout the glass container industry and was active in the development of some of the early machines used in that line of production.

* See *The Bulletin*, **16** [2] 73–74 (1937).

WILLARD D. RICHARDSON

Mr. Richardson passed away Monday, July 18. He suffered cerebral hemorrhages early in June that paralyzed his right side. He could not speak. He suffered three shocks. He died peacefully, apparently asleep. His funeral was held July 20 at 3:30 P.M., cremation following immediately.

A Charter Member of the American Ceramic Society, a Past-President, Editor of *Transactions*, a Fellow, and for forty years a consistent contributor to all the activities



Willard D. Richardson

of the Society, Willard D. Richardson earned a place in ceramic history never to be overlooked. He made a record that will endure.

Not alone in this Society, but in all organized activities, especially in the National Brick Manufacturers Association, he took a leading rôle as officer, committeeman, and lay member. He never hesitated to give of his strength, time, knowledge, and skill.

When Edward Orton, Jr., was striving with legislators of Ohio and with the Board of Trustees of the Ohio State University to establish a Department of Ceramic Engineering, Mr. Richardson was one of his most active supporters. Many a vote for the "mud-pie" course was won by his quiet persistent lobbying.

Willard D. Richardson made for himself a large place in ceramic history.

A life history and complete list of his publications was published in the Communications Section of the July issue of *The Bulletin*, and his photograph taken many years ago appeared on the front cover of the same issue.

YOU CAN DO NOTHING FOR THE AMERICAN CERAMIC SOCIETY
All That You Can Do by and through This Society, You Do for *Yourself and Fellow Ceramists*

ACTIVITIES OF THE SOCIETY

RESOLUTIONS OF FELLOWS OF THE AMERICAN SOCIETY ON THE DEATH OF J. W. MELLOR

Mrs. J. W. Mellor,
Stoke-on-Trent, England

Dear Mrs. Mellor:

The Fellows of the American Ceramic Society express their deep sympathy to you over the loss of their Fellow and Honorary Member, Joseph William Mellor.

A resolution to this effect has been spread upon the minutes of the Fellows of the Society.

Dr. Mellor's extensive and precious contributions to ceramic and chemical science have made a permanent impression which will serve as a monument for all time. His interest in art and his genial contacts have left an indelible imprint on those who were fortunate enough to know him. A great man has been lost to science and to humanity.

The Fellows of the Society wish also to place themselves on record as recognizing the important part which you, Mrs. Mellor, have played in the Doctor's career through your editing of his publications, a fact little known to scientists. They hope that you will have the health and strength to complete the publication of material which accumulated and which has not yet reached the press.

Sincerely,

—ALEXANDER SILVERMAN, *Chairman,*
Committee on Honorary Membership of the Fellows

CERAMIC HISTORY ON COVER OF THE BULLETIN

Do you like this idea?

Will you make suggestions, and will you secure photographs and historical stories? Will you mail these in as early as possible?

If you have historical or even modern examples of ceramic ware, equipment, or material for the Society's museum, please send them in.

If you have a collection of specimens of ceramic materials and of minerals and wish to spare some to add to the Society's collection, send them in, please.

Here is a testimony.

"I regard your historical biographical sketches very highly and have had these front cover pages bound with my *Bulletins* so that a permanent record will be made of them. While I can not contribute anything in the way of the history of the various types of ceramic materials, I heartily approve of your continuing along this line for these contributions are very much worth while to all of us who do not have the opportunity to delve into these matters."

—H. M. KRANER, *Bethlehem Steel Corporation*

CHESTER H. PARMELEE WANTS YOUR AID ON IMPURITIES IN GASEOUS FUELS*

Ceramic users of gaseous fuels would be interested in knowing the nature and quantity of the sulfur compounds now grouped under the heading of total sulfur. Ceramic users would be interested in knowing whether this total sulfur consists of carbon bisulfide, carbon oxysulfide, sulfur dioxide, and sulfur trioxide, the organic sulfur compounds known as mercaptans, or thiophene.

Your Committee's attention is called to a report, published in the *Proceedings of the American Gas Association* for 1931, page 1082, entitled "Process for Reduction of Organic Sulphur in City Gas," by E. J. Menery, Peoples Gas Co., Glassboro, N. J. Your Committee's attention is also called to the work now being done by the Committee on Gas Conditioning of the American Gas Association of which O. S. Hegerman, 420 Lexington Ave., New York, is chairman, where we understand that a project is in progress on organic sulfur removal which will soon be reported.

The American Ceramic Society is canvassing its more than 2000 members through its publication, known as *The Bulletin*, for further information on this subject and particularly trying to bring out the effects on ceramic products of the different kinds of sulfur impurities in gaseous fuels. If this canvass reveals simple and accurate methods for the determination of these impurities, I shall be glad to relay this information to the Committee for their information and suitable action.

—C. H. PARMELEE, *Onondaga Pottery Co., Syracuse, N.Y.*

* See *Bull. Amer. Ceram. Soc.*, **17** [5] 238 (1938).

GLASS DIVISION PROGRAM FOR TENTH AUTUMN MEETING

Old Point Comfort, Hotel Chamberlin

Friday, September 9

(1) Evening: Leave Baltimore at 6:30 P.M. (E.S.T.) for Old Point Comfort *via* Old Bay Line steamer

Saturday, September 10

(2) Morning: Arrive Old Point Comfort, Hotel Chamberlin

(3) " Technical Session 9:30 A.M. to 12:00 M.

Reports on Physical Testing

9:30 A.M. Mechanical Strength
- (1) J. T. Littleton
- (2) J. Bailey
- (3) A. N. Finn

10:45 A.M. Thermal Endurance
- (1) S. R. Scholes

11:15 A.M. Work on Bottle Breakage
- (1) F. W. Preston

(4) Afternoon: Golf, swimming, Williamsburg trip.

(5) Evening: Informal banquet followed by dancing on Marine Roof.

Sunday, September 11

(6) Morning: Round Table Discussion on Chemical Analysis
10:30 A.M. Introduction: G. E. F. Lundell

(7) Afternoon: Golf, swimming, lounging

(8) Evening: Leave Old Point Comfort 7:30 (E.S.T.) for Baltimore *via* Old Bay Line

Monday, September 12

(9) Morning: Arrive in Baltimore 6:30 A.M. (occupancy until 8:30 A.M.). Breakfast on boat.

ALL-EXPENSE RATES FOR TENTH AUTUMN MEETING GLASS DIVISION

Rates include round-trip transportation Baltimore to Old Point *via* Old Bay Line Steamer, meals, stateroom, and hotel room. Rates are quoted on *double occupancy* at Hotel. If single occupancy at hotel is desired, add $1.00 to rates quoted.

	Steamer accommodations	Single occupancy	Double occupancy	
$1.75	Outside upper and lower berthroom	$17.50	$15.75	each
2.25	Outside upper and lower berthroom with shower *or* toilet	18.50	16.25	"
2.75	Outside upper and lower berthroom with tub bath *and* toilet	19.50	16.75	"
3.00	Outside double bedroom	20.00	17.00	"
3.25	Outside double bedroom with toilet	20.50	17.25	"
3.50	Outside double bedroom with toilet	21.00	17.50	"
4.00	Outside double bedroom with tub bath and toilet *or* shower bath and toilet	22.00	18.00	"
4.00	Outside bedroom, double bed and single bed with toilet		18.00	"
4.25	Outside double bedroom with tub bath and toilet	22.50	18.25	"
4.50	Outside twin bedroom with tub bath and toilet	23.00	18.50	"

Reservation blanks will be sent to all members of the Glass Division.

Others interested in attending this meeting should contact W. R. Lester, Maryland Glass Corp., Baltimore, Md.

REFRACTORIES DIVISION AUTUMN MEETING

Friday and Saturday, September 2 and 3

Technical Session: Friday afternoon, 1:00 P.M. (E.S.T)
Subject: "Steel Mill Pouring Pit Refractories."
Guest Speaker: WALTER J. REES, Dept. of Refractory Materials, Univ. of Sheffield, Sheffield, England.

Papers will be presented by representatives of Bethlehem Steel Co., Carnegie-Illinois Steel Co., Pittsburgh Steel Co., and Timken Roller Bearing Co.

Entertainment: Friday evening, banquet and dancing; bridge for women, Friday afternoon; sports include golf, tennis, horseback riding, and swimming.

—GILBERT SOLER, *Program Chairman*

Committee C-8, A.S.T.M., Thursday, September 1

Committee C-8, A.S.T.M. will meet at 2:30 P.M. at Bedford Springs, September 1.

WHITE WARES AND MATERIALS AND EQUIPMENT DISCUSSION SUBJECTS

(1) "Organic Electrolytes, Wetting and Plasticizing Agents for Cast, Dry Press, and Plastic Bodies."

(2) "Improved Processing and Control Methods for Ceramic Raw Materials in View of Possible Future Demands and Applications."

ADVANCE MEETING SCHEDULES

Division	Place	Date
White Wares and Materials and Equipment	Bedford Springs Hotel, Bedford, Pa.	September 15–17
Glass	Chamberlain Hotel, Old Point Comfort, Va.	September 9–12
Refractories	Bedford Springs Hotel, Bedford, Pa.	September 2–3
Art	Dearborn Inn, Dearborn, Mich.	October 24–25
Art	Ceramic Exhibit, Syracuse Museum	October 27–Nov. 21
Art	Pittsburgh, Pa.	January, 1939
Enamel	P.E.I. Forum, Univ. of Illinois	October 12–14
All Divisions Forty-First Annual Meeting	Stevens Hotel, Chicago, Ill.	April 16–22, 1939
General Autumn Meeting	San Francisco	September, 1939

FORTY-FIRST ANNUAL MEETING, CHICAGO

As evidence that this will be a grand meeting the leaders of the local committees are here presented to you.

FRANK E. HODEK, JR.

Frank E. Hodek, Jr., has been elected to serve as Chairman of the Chicago Local Committee for the Forty-First Annual Meeting of the American Ceramic Society to be held at the Stevens Hotel the week of April 16, 1939.

Education and Industrial Work

Graduate: Grammar school, 1907.
Graduate: Oak Park, Ill., High School, 1911.
Post-Graduate work: Business course, Oak Park High School, 1912. Entered porcelain enameling business, 1916.
Secretary-Treasurer: General Porcelain Enameling & Mfg. Co., Chicago, Ill.; Steffenguide, Inc., Chicago, Ill.; Century Vitreous Enamel Co., Chicago, Ill.
Treasurer: White-Way Industries, Inc., Milwaukee, Wis.

Association Work

Secretary-Treasurer: Chicago District Enamelers' Club since 1924.
Past-President: Chicago Section, American Ceramic Society.
Past Vice-President: Porcelain Enamel Institute.
Chairman: Porcelain enamel parade, Century of Progress, (Chicago, 1933–1934) and Porcelain Enamel Institute Annual Forum.
President: Porcelain Enamel Institute.
Member: Advisory Council, Dept. of Ceramic Engineering, Univ. of Illinois, and Conference on Higher Education in Illinois, Univ. of Illinois.
Chairman, Past Vice-President, and Past-President: Legislative Committee of Northwest Associated Manufacturers, Inc., Chicago, Ill.

Member: Committees in Illinois Manufacturers Assn., Chicago, Ill.
Chairman: Y.M.C.A. boys and girls' summer camp, Lake Hastings, Ill.
President: Board of Directors, Irving Park Dept., Chicago Y.M.C.A.
Member: American Ceramic Society, 1923; American Ceramic Society European Tour, 1928.

Frank E. Hodek, Jr.

A. L. VODICKA

A. L. Vodicka is president of the Chicago Local Section of the American Ceramic Society. He has been a member of the Society since 1922 and will be active in plans for the Forty-First Annual Meeting to be held at the Stevens Hotel in Chicago, Ill., the week of April 16, 1939.

Albert L. Vodicka was born on July 6, 1886, in Austria, Europe. He came to this country in April, 1889. His father came over to the United States from Prague, Bohemia, one year before to start the L. Wolff Manufacturing Company, Chicago, Ill., in porcelain enameling sanitary ware.

Mr. Vodicka was graduated from grammar school in 1900 at the age of 14 years. During the vacation, he entered the employ of the Wolff Manufacturing Company, and, when school started again, he stayed at work, assisting his father. Three or four years later he was made assistant general foreman.

In 1911, his father retired, and he was given his father's position as general foreman. Mr. Vodicka stayed with the L. Wolff Manufacturing Company until October, 1919, when he left its employ to start the Aetna Porcelain Enameling Company in the manufacture of porcelain enameled cast-iron ware; he is now president and general manager of this Company.

Mr. Vodicka is married and has four children. He is a member of the Masonic Fraternity, Chapter Commandery and Shrine, and the Medinah Country Club His sports are swimming, fishing, and golf in the summer, and bowling in the winter.

A. L. Vodicka

REXFORD NEWCOMB, JR.

Rexford Newcomb, Jr., was graduated from the University of Illinois, Urbana, Ill., in June, 1936, with a B.S. in Ceramic Engineering. His extra-curricular activities were many and varied, including participation in 14 dramatic productions, both on cast and production staffs. He was also vice-president of the Illinois Union, president of the Student Branch (2 years), president of the Engineering Council, and chairman of St. Pat's Ball. He was active in military, and at the present time is in the 497th Field Artillery.

Immediately after leaving school, Mr. Newcomb became associated with the East Chicago works of the Harbison-Walker Refractories Company as assistant plant engineer. In September, 1936, he became control man in the Detroit plant of the Norge Division, Borg-Warner Corporation. At the present time, he is on the editorial staff of *Ceramic Industry*. Mr. Newcomb is married and has one son.

Mr. Newcomb has been a member of the American Ceramic Society since 1936. He is serving as secretary-treasurer of the Chicago Section and is secretary of the Local Committee for the Forty-First Annual Meeting of the American Ceramic Society, which is to be held in Chicago during the week of April 16, 1939.

WATCH YOURSELF GROW
BY GETTING MORE NEW MEMBERS

Rexford Newcomb, Jr.

NEW MEMBERS

Corporation

*NATIONAL ENGINEERING CO., Edwin M. Rupp (voter), 549 West Washington Blvd., Chicago, Ill.

UNITED GLASS BOTTLE MFGRS. LTD., T. C. Moorshead (voter), 8 Leicester St., London, W. C. 2, England.

VICTOR INSULATORS, INC., P. W. Price (voter), Victor, N. Y.

Personal

*BLUME, ARTHUR J., Square D Co., Peru, Ind.; ceramic engineer.

CONNELL, GEORGE A., 510 W. Sixth St., Los Angeles, Calif.; technical director, Pacific Coast Borax Co.

EARLY, JOSEPH, 407 Peoples East End Bldg., Pittsburgh, Pa.; consulting engineer, Arthur W. Schmid.

HENDERSON, CHESTER E., 14055 Mark Twain, Detroit, Mich.; Ford Motor Co.

JORDAN, ROY E., SR., Mosaic Tile Co., 443 W. 41st St., New York, N. Y.; president.

*MAYFIELD, CHESTER C., Box 55, Blackfork, Ohio; superintendent, Cambria Clay Products.

PEREIRA, ARMANDO DE ARRUDA, Ceramica Sao Caetano, Sao Paulo, Brazil; director.

RAGHUNATH, N. V., Locke Insulator Corp., Baltimore, Md.; manager, Government Porcelain Factory, Bangalore, India.

* Indicates former member of Society rejoining for 1938.

*RUPP, EDWIN M., 216 Glencoe Rd., Columbus, Ohio; National Engineering Co., Chicago, Ill.

UDA, SATORU, Nippon Sheet Glass Co., Chitose-cho, Yokkaichi City, Japan; factory manager.

Student

CONNER, HARVEY, Avoca, N. Y. (N. Y. State College of Ceramics.)

FELTER, WARREN B., JR., 1989 Iuka Ave., Columbus, Ohio. (Ohio State University.)

FRIEDMAN, BARNETT R., 1745 E. 21st St., Brooklyn, N. Y. (N. Y. State College of Ceramics.)

MULLER, MAX M., 91 East Patterson Ave., Columbus, Ohio. (Ohio State University.)

NIES, NELSON P., Western Reserve Univ., Cleveland, Ohio.

WOOD, T. RICHARD, 5203 West Hudson St., Seattle, Wash. (University of Washington.)

MEMBERSHIP WORKERS' RECORD

Corporation

Office	3

Personal

A. Lee Bennett	1	F. S. Thompson	1
J. L. Carruthers	3	W. A. Weldon	1
J. T. Ogden	1	Office	3

Student

M. J. Bahnsen	1	R. M. King	1
V. V. Kelsey	4		
		Grand Total	**19**

ROSTER CHANGES DURING JULY*

Personal

DE ARTIGAS, J. ANTONIO, 1 bis, Place des Saussaies, Paris 8(e), France. (Madrid, Spain)

CANNAN, WILLIAM, JR., Stonewall Jackson Hotel, Clarksburg, W. Va. (Rochester, N. Y.)

FOSTER, HARRY D., 1976 N. 4th St., Columbus, Ohio. (Massillon, Ohio)

MINTON, LEWIS G., Seville, Ohio. (Alhambra, Calif.)

TARNOPOL, MILTON S., 11 Mifflin Place, Cambridge, Mass. (Columbus, Ohio)

WEBSTER, CHARLES E., 1780 South Center Blvd., Springfield, Ohio. (Pittsburgh, Pa.)

Student

BUCK, IVAN, 22 West Sixth St., Emporium, Pa. (Pennsylvania State College)

CUDNEA, PIERRE, Route 2, Geauga County, Chesterland, Ohio. (Cleveland School of Art)

DAMMANN, ARTHUR, 4725 15th St., N. E., Seattle, Wash. (University of North Carolina)

ELLIS, JAMES L., 506A 6th Ave., Medicine Hat, Alberta, Canada. (University of Saskatchewan)

GREENE, KENNETH T., Alfred, N. Y. (Rutgers Univ.)

HENDREN, ROBERT R., 8511 Tioga Ave., Cleveland, Ohio. (Ohio State University)

NIKLEWSKI, BRONISLAW, JR., Tennessee Enamel Mfg. Co., 42nd and Park Ave., Nashville, Tenn. (Univ. of Ill.)

REID, JOHN O., 622 Bergen Ave., Jersey City, N. J. (Alfred University)

RIGGS, S. GRAHAM, JR., 2406 Hillsboro St., Raleigh, N. C. (University of North Carolina)

SAWYER, JOHN P., JR., 411 West Main St., Elizabeth City, N. C. (University of North Carolina)

SCHOEPPEL, NORMAN, 417 East Jackson St., Mexico, Mo. (University of Illinois)

SMITH, DONALD I., 917 18th St., N. W., Apt. 22, Washington, D. C. (Pennsylvania State College)

ZINSZER, WILLIAM K., 401 12th St., Hays, Kansas. (University of Alabama)

* Address in parentheses is the former address.

CORPORATION MEMBERS ARE NEEDED

A decrease of eight in number of Ceramic Corporation Members as of July 19 makes impossible any crowing over the shown all-time high record of paid members plus subscribers.

PAID MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1936	1452	196				
December 22, 1937	1713	220	12	523	220	2688
January 22, 1938	1712	220	12	530	220	2694
February 18, 1938	1728	217	15	540	220	2720
March 18, 1938	1770	216	10	513	220	2729
April 18, 1938	1635	205	60	527	220	2647
May 19, 1938	1643	208	52	548	220	2671
June 21, 1938	1675	210	49	563	220	2717
July 19, 1938	1687	212	41	573	220	2733

No Ceramic Corporation is a piker or slacker. Each one would pay at least $25.00 annually and give support to this, their only organization which is devoted exclusively to the promotion of their welfare in ceramic arts, science, and technology.

Why not tell them of this, their privilege?

Here is the roster of those Ceramic Corporations who, by $25.00 (minimum), are supporting this Society.

Who is to blame for all Ceramic Corporations, not being on this roster?

JULY ROSTER OF CORPORATION MEMBERS

Abbé Engineering Co., New York, N. Y.
Abingdon Sanitary Mfg. Co., Abingdon, Ill.
A C Spark Plug Co., Flint, Mich.
Akron Porcelain Co., Akron, Ohio
Aluminum Ore Co., East St.Louis, Ill.
American Gas Assn., New York, N. Y.
American Lava Corp., Chattanooga, Tenn.
American Nepheline Corp., Rochester, N. Y.
American Potash & Chemical Corp., New York, N. Y.
American Refractories Institute, Pittsburgh, Pa.
American Rolling Mill Co., Middletown, Ohio
American Sheet & Tin Plate Co., Pittsburgh, Pa.
American Stove Company, St. Louis, Mo.
Amsler-Morton Co., Pittsburgh, Pa.
Arketex Ceramic Corp., Brazil, Ind.
Atlantic Terra Cotta Co., Perth Amboy, N. J.

Babcock & Wilcox Co., New York, N. Y.
Ball Brothers Co., Muncie, Ind.
Baltimore Enamel & Novelty Co., Baltimore, Md.
Bausch & Lomb Optical Co., Rochester, N. Y.
Binghamton Brick Co., Inc., Binghamton, N. Y.
Blythe Colour Works, Ltd., Cresswell, Stoke-on-Trent, England
Bonnot Company, Canton, Ohio
Brockway Glass Company, Inc., Brockway, Pa.
Buck Glass Company, Baltimore, Md.
Buffalo Pottery, Buffalo, N. Y.

Canadian General Electric Co., Ltd., Peterborough, Ontario, Canada
Canton Stamping & Enameling Co., Canton, Ohio
Carborundum Company, Niagara Falls, N. Y.
Carr-Lowrey Glass Co., Baltimore, Md.
Celo Mines, Inc., Burnsville, N. C.
Central Silica Company, Glenford, Ohio
Ceramic Color & Chemical Mfg. Co., New Brighton, Pa.
Certain-Teed Products Corp., Buffalo, N. Y.
Champion Spark Plug Co., Detroit, Mich.
Chattanooga Glass Co., Chattanooga, Tenn.
Chicago Hardware Foundry Co., North Chicago, Ill.
Chicago Pottery Co., Chicago, Ill.
Chicago Vitreous Enamel Product Co., Cicero, Ill.
Clark, N., & Sons, San Francisco, Calif.
Clay Products Association, Chicago, Ill.
Coors Porcelain Company, Golden, Colo.
Corhart Refractories Co., Inc., Louisville, Ky.
Corning Glass Works, Corning, N. Y.
Corning Glass Works, Macbeth-Evans Div., Charleroi, Pa.
Cortland Grinding Wheels Co., Chester, Mass.
Crane Enamelware Company, Chattanooga, Tenn.
Crooksville China Co., Crooksville, Ohio
Crossley Machine Co., Trenton, N. J.
Crossman Company, South Amboy, N. J.
Crown Potteries Co., Evansville, Ind.

Detroit Electric Furnace Co., Detroit, Mich.
DeVilbiss Co., Toledo, Ohio
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Drakenfeld, B. F., & Co., New York, N. Y.
Du Pont de Nemours, E. I., & Co., R. & H. Chemical Dept., Wilmington, Del.

Edgar Plastic Kaolin Co., Metuchen, N. J.
Electro Refractories & Alloys Corp., Buffalo, N. Y.
Engelhard, Charles, Inc., Newark, N. J.
English China Clays Sales Corp., New York, N. Y.
Eureka Flint & Spar Co., Trenton, N. J.
Exolon Company, Blasdell, N. Y.

Federal Seaboard Terra Cotta Corp., Perth Amboy, N. J.
Ferro Enamel Corp., Cleveland, Ohio
Findlay Clay Products Co., Washington, Pa.
Fostoria Glass Co., Moundsville, W. Va.
Frazier-Simplex, Inc., Washington, Pa.

Gayner Glass Works, Salem, N. J.
General Ceramics Co., New York, N. Y.
George, W. S., Pottery Co., East Palestine, Ohio
"Giesche" Fabryka Porcelany Sp. Akc., Katowice-Bogucice, Poland
Gillinder Brothers, Inc., Port Jervis, N. Y.
Gladding, McBean, & Co., Lincoln, Placer County, Calif.
Gleason-Tiebout Glass Co., Maspeth, N. Y.
Glenwood Range Co., Taunton, Mass.
Grammes, L. F., & Sons, Inc., Allentown, Pa.
Great Lakes Foundry Sand Co., Detroit, Mich.
Great Lakes Steel Corp., Detroit, Mich.
Green, A. P., Fire Brick Co., Mexico, Mo.

Haeger Potteries, Inc., Dundee, Ill.
Hall China Company, East Liverpool, Ohio
Hanley Company, Summerville, Pa.
Hanovia Chemical & Mfg. Co., Newark, N. J.
Hardinge Company, Inc., York, Pa.
Harshaw Chemical Co., Cleveland, Ohio
Hartford-Empire Co., Hartford, Conn.
Hazel-Atlas Glass Co., Zanesville, Ohio
Hocking Glass Co., Lancaster, Ohio
Hommel, O., Co., Pittsburgh, Pa.
Houze, L. J., Convex Glass Co., Point Marion, Pa.

Illinois Clay Products Co., Joliet, Ill.
Ingram-Richardson Mfg. Company of Indiana, Inc., Frankfort, Ind.
International Smelting & Refining Co., East Chicago, Ind.
Irish Glass Bottle Co., Ltd., Dublin, Ireland
Ironton Fire Brick Co., Ironton, Ohio
Isolantite, Incorporated, Belleville, N. J.

Kaolin, Incorporated, Spruce Pine, N. C.
Kentucky Clay Mining Co., Mayfield, Ky.
Kentucky-Tennessee Clay Co., Mayfield, Ky.
Knowles, Edwin M., China Co., Newell, W. Va.
Kohler Company, Kohler, Wis.
Koppers Construction Co., Pittsburgh, Pa.
Kraftile Company, Niles, Calif.

Laclede-Christy Clay Products Co., St. Louis, Mo.
Lancaster Iron Works, Lancaster, Pa.
Lapp Insulator Co., Inc., Le Roy, N. Y.
Laughlin, Homer, China Co., Newell, W. Va.
Lava Crucible Co. of Pittsburgh, Pittsburgh, Pa.
Lee Clay Products Company, Clearfield, Ky.
Libbey Glass Company, Toledo, Ohio
Lindemann, A. J., & Hoverson Co., Milwaukee, Wis.
Locke Insulator Corp., Baltimore, Md.
London Brick Co., London, England
Louthan Manufacturing Co., Ltd., East Liverpool, Ohio
Lynch Corporation, Anderson, Ind.
Lynch, A. J., & Co., Los Angeles, Calif.

Maryland Glass Corp., Baltimore, Md.
Mason City Brick & Tile Co., Mason City, Iowa
McHose, L. H., Inc., Perth Amboy, N. J.
McKee, Arthur G., & Co., Cleveland, Ohio
Metal & Thermit Corp., New York, N. Y.
Mississippi Glass Co., New York, N. Y.
Mitchell Clay Mfg. Co., St. Louis, Mo.
Moore & Munger, New York, N. Y.
Mosaic Tile Company, Zanesville, Ohio
Mt. Clemens Pottery Co., Mt. Clemens, Mich.

National Engineering Co., Chicago, Ill.
National Fireproofing Corp., Pittsburgh, Pa.
National Industrial Sand Assn., Washington, D. C.
National Lime and Stone Co., Findlay, Ohio
Newbold Silica Fire-Brick Co., Ltd., Sydney, N.S.W., Australia
New Castle Refractories Co., New Castle, Pa.
New Jersey Porcelain Co., Trenton, N. J.
New Jersey Pulverizing Co., New York, N. Y.
Nippon Gaishi Kabushiki Kaisha, Nagoya, Japan
Nippon Toki Kaisha, Ltd., Nagoya, Japan
North American Refractories Co., Cleveland, Ohio
North Carolina Feldspar Corp., Erwin, Tenn.
Norton Company, Worcester, Mass.

Ohio Insulator Company Div., Ohio Brass Co., Barberton, Ohio
Onondaga Pottery Co., Syracuse, N. Y.
Orton, Edward, Jr., Ceramic Foundation, Columbus, Ohio
Owens-Illinois Glass Co., Alton, Ill.
Owens-Illinois Pacific Coast Co., San Francisco, Calif.

Pacific Clay Products, Los Angeles, Calif.
Paper Makers Importing Co., Inc., Easton, Pa.
Pass & Seymour, Inc., Solvay, N. Y.
Pennsylvania Pulverizing Co., Lewistown, Pa.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Pfaudler Company, Rochester, N. Y.
Pittsburgh Plate Glass Co., Creighton, Pa.
Porcelain Enamel & Mfg. Co., Baltimore, Md.
Portsmouth Clay Products Co., Portsmouth, Ohio
Potters Supply Co., East Liverpool, Ohio
Precision Grinding Wheel Co., Philadelphia, Pa.

Quigley Company, Inc., New York, N. Y.

Ransome Concrete Machinery Co., Dunellen, N. J.
Republic Steel Corp., Youngstown, Ohio
Rickmann & Rappe, Koln-Kalk, Germany
Riddell, W. A., Co., Bucyrus, Ohio
Rochester & Pittsburgh Coal Co., Indiana, Pa.
Roseville Pottery Co., Zanesville, Ohio
Ross-Tacony Crucible Co., Philadelphia, Pa.
Rundle Manufacturing Co., Milwaukee, Wis.
Rustless Iron Co., Ltd., Keighley, England

Safety Grinding Wheel & Machine Co., Springfield, Ohio
Salem China Company, Salem, Ohio
San Miguel Brewery, Inc., Manila, P. I.
Sebring Pottery Company, Sebring, Ohio
Shenango Pottery Company, New Castle, Pa.
Simonds Worden White Co., Dayton, Ohio
Smith & Stone, Ltd., Georgetown, Ontario, Canada
Solar Laboratories, Beaver, Pa.
Solvay Process Company, Syracuse, N. Y.
Southern California Gas Co., Los Angeles, Calif.
Spinks, H. C., Clay Co., Newport, Ky.
Square D Company, Detroit, Mich.
Standard Sanitary Mfg. Co., Louisville, Ky.
Star Porcelain Co., Trenton, N. J.
Stark Ceramics, Inc., Canton, Ohio
Steele, J. C., & Sons, Statesville, N. C.
Sterling Grinding Wheel Co., Tiffin, Ohio
Summitville Face Brick Co., Summitville, Ohio
Sur Enamel & Stamping Works, Ltd., Calcutta, India
Swindell Brothers, Baltimore, Md.
Swindell-Dressler Corp., Pittsburgh, Pa.

Taylor, Smith, & Taylor Co., Chester, W. Va.
Toyo Toki Kwaisha, Kokura City, Japan
Trenton Potteries, Trenton, N. J.
Twyfords, Limited, Stoke-on-Trent, England
Tyler, W. S., Company, Cleveland, Ohio

Union Electrical Porcelain Works, Trenton, N. J.
Union Française des Produits Refractaires, Paris, France
United Clay Mines Corp., Trenton, N. J.
United Glass Bottle Mfrs., Ltd., London, England
United States Gypsum Co., Chicago, Ill.

Universal Clay Products Co., Sandusky, Ohio
Universal Dental Co., Philadelphia, Pa.
Universal Sanitary Mfg. Co., New Castle, Pa.

Verreries Souchon Neuvesel, Lyon, France
Vesuvius Crucible Co., Swissvale, Pa.
Victor Insulators, Inc., Victor, N. Y.
Vitrefrax Corporation, Los Angeles, Calif.
Vitreous Steel Products Co., Cleveland, Ohio
Vitro Manufacturing Co., Pittsburgh, Pa.
Vollrath Company, Sheboygan, Wis.

Wallace China Co., Ltd., Huntington Park, Calif.
Waltham Grinding Wheel Co., Waltham, Mass.
Wayne Laboratories, Waynesboro, Pa.
Western Brick Co., Danville, Ill.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Derry, Pa.
Wheeling Steel Corp., Portsmouth, Ohio
Whitall-Tatum Co., Millville, N. J.

CERAMIC MATERIALS COMMITTEE, INDUSTRIAL MINERALS DIVISION, A. I. M. M. E.

B. C. BURGESS, *Chairman:* Tennessee Mineral Products Corp., Spruce Pine, N. C.
G. M. CARRIE: Canadian Refractories, Ltd., Montreal, Quebec.
G. C. CROSSLEY: United Clay Mines Corp., Trenton, N. J.
W. E. DORNBACH: General Refractories Co., San Mateo, Calif.
W. D. KELLER: Univ. of Missouri, Columbia, Mo.
V. L. MATTSON: Celo Mines, Inc., Burnsville, N. C.
ERWIN SOHN: Standard Sanitary Mfg. Co., Louisville, Ky.

SEVENTH NATIONAL CERAMIC EXHIBITION

The Seventh National Ceramic Exhibition (the Robineau Memorial) will be held at the Syracuse Museum of Fine Arts from October 27 to November 21, opening with a preview and reception on the evening of October 27. All works must be received on or before October 15. Full conditions with prizes offered, etc., will be mailed out early in September. For the first time, Canadian ceramists are invited to participate.

The Jury of Selection and Award includes the following: *Chairman*: William M. Milliken, Director, Cleveland Museum of Art; R. Guy Cowan, representing the American Ceramic Society; Waylande Gregory, sculptor; Walter H. Siple, Director, Cincinnati Art Museum. The California Committee is Dorothy Liebes, Chairman, Decorative Arts Section, Golden Gate Exposition; Grace McCann Morley, Director, San Francisco Museum; Reginald Poland, Director, San Diego Museum.

By national agreement Syracuse has become an annual "clearing-house," as it were, for the assembling of works in the ceramic field. Dorothy Liebes, Chairman of the Decorative Arts Section, has written to the Syracuse Museum: "The Exposition is sponsoring one of the most progressive programs in the decorative arts field ever featured in America, and we are certain that your ceramic collection will be one of the focal points of interest. This splendid exhibit will not only aid us in presenting a comprehensive ceramic unit, but will also add to the already great and well-deserved prestige of your annual Robineau Memorial Exhibition. Please be assured of our awareness of this unique opportunity to present something very fine to the great public which will be coming to the Fair."

Student Branch at New York State College of Ceramics for 1937–1938

NEW YORK STATE COLLEGE OF CERAMICS STUDENT BRANCH REPORT*

The officers for 1937–1938 were *President,* Jud Gustin; *Vice-President,* Rodney Jones; *Secretary,* Desmond Teague; and *Treasurer,* Joyce Wannamaker.

The officers elected for 1938–1939 are *President,* Joseph Proe; *Vice-President,* Lucius Washburn; *Secretary,* Martin E. Dykeman; and *Treasurer,* Julius Siegel.

This Student Branch convenes each month unless it is absolutely impossible to do so; it is somewhat guided by attainment of speakers and scholastic activities.

It has enjoyed and has been benefited by such speakers as Dr. Hall, Onondaga Pottery Co.; Dr. Shaw, Western Electric Co.; Dr. Rosenberg, O. Hommel Co., Inc.; J. W. Craig, Canadian Refractories, Ltd.; and O. H. Read, A. P. Green Fire Brick Co.

Under the guidance of the senior members, the outstanding social event of the year, the St. Pat's Festival, held attention for two days, with open house, a tea dance, a formal ball, a parade with the appearance of St. Pat, and an amateur show, followed by moving pictures, making a well-rounded program.

Approximately seventeen students attended the Fortieth Annual Meeting of the Society held at New Orleans this year, and each one was gratified at the contact with the industry and the men in the industry in which they hope to participate in the future.

—DESMOND TEAGUE, *Secretary*

* Received July 11, 1938.

INTERNATIONAL CHEMISTRY MEETINGS

By Alexander Silverman

As the delegate of the American Ceramic Society and the United States Government to the Tenth International Congress of Chemistry, Rome, Italy, May 14 to 21, 1938, the writer submits the following report. About 2750 chemists from various parts of the world were in attendance. Registration took place at the University of Rome.

Meetings and Entertainment

On May 14, a reception was held in the tropical gardens of the Hotel Russie. The official opening of the Congress was conducted on May 15 at the Capitol in Rome. An address, "The Conquests of Chemistry," was delivered by Nicola Parravano, President of the Congress. King Victor Emmanuel of Italy welcomed the guests; visits were made to the Colosseum and many other ancient monuments, and later the Minister of Education received the delegates at the Palatine.

On May 16 and throughout the week, twenty-two formal lectures were given.

On May 17, there was a trip to Ostia, the ancient Mediterranean port of Rome, and on May 19, a visit was made to Tivoli and the Villa d'Este. The magnificent palace is provided with a terraced garden equivalent in height to a ten-story building and is replete with many beautiful fountains. After luncheon in the Castelli Romani, the party proceeded to Frascati and other wine-growing regions near Rome.

On the evening of May 16, the Rome Symphony Orchestra gave a special concert; on May 18, the Mayor of Rome received at the capitol; and on May 20, the Royal Opera House was reserved exclusively for the scientists. Giordano's "Il Re" and Mascagni's "Cavalleria Rusticana" constituted the program, with the composers conducting and with the greatest opera stars of Italy in the cast.

The "Gala Dinner," the banquet which terminates the meetings of the Congress and the Union, was held on May 21. Because of the large attendance, guests were distributed in various hotels, and the speeches were broadcast from the Grand Hotel.

On Sunday, May 22, there was an exodus from Rome to other parts of Italy by various touring groups; one group, of which your delegate was a member, spent four days in Naples, Pompeii, Amalfi, and Capri; included with the sight seeing were trips to an oil refinery and to a steel plant. On each of the several tours given, industrial plants of interest to members of the Congress were included.

Sections of the Congress

Besides the general lectures, about 450 papers were presented before sections of the Congress: (I) chemistry and scientific thought; (II) basic chemical products; (III) chemistry and the utilization of energy; (IV) food chemistry; (V) chemistry of housing and clothing; (VI) health and hygiene; (VII) documentation, including advertising and publication; (VIII) agriculture; (IX) chemical industry; (X) chemistry of transportation; and (XI) chemistry and national defense.

The International Union

This standards body of the world in chemistry is composed of delegates from various nations. At the XIII Conference in Rome, twenty nations were represented. The representation depends on the size and scientific importance of the nation, and no country is entitled to more than fifteen delegates. The delegates are chosen by the respective governments. One hundred and fifty delegates were in attendance, representing Germany (including Austria), Belgium, Brazil, Bulgaria, Denmark, the United States, France, England, Italy, Japan, Norway, Holland, Poland, Portugal, Roumania, Sweden, Switzerland, Czechoslovakia, Uruguay, and Jugoslavia. As anticipated, no delegates were present from Spain, Russia, or China. It is regrettable that, with the international aspects of science, the political locale of the meeting should have kept the representatives of these nations away.

Of the delegates chosen by a nation, only 40% have a voting power in the business sessions of the Union. These are councillors and the remainder are called delegates.

To Meet in England in 1941

The Council of the Union determines the business policy, the location of meetings, which are generally held biennially, and the personnel of the various international committees. The next meeting, through a special concession, is scheduled for England in 1941, in connection with the centennial celebration of the London Chemical Society. Marston T. Bogert of Columbia University was elected President of the International Union and the International Congress for the next four years. Four new vice-presidents were elected, including R. E. Swain of Leland Stanford University.

The committees of the International Union include finance, atomic weights, radioactive constants, thermochemistry, standard cells, terminology and nomenclature, annual tables of constants, physicochemical constants, physical atomic weights and isotopes, new analytical methods, international publications, agriculture, and constitution and by-laws. The following committee reports were approved for 1938: International Table of Stable Isotopes, International Table of Atomic Weights, Physicochemical Constants and the Creation of a Bureau for Their Publications, Physicochemical Data and Standards, Reform of Inorganic Nomenclature, Leather Products, Analytical Reactions, Thermochemistry, Finance, Constitution and By-Laws.

The work of the International Union of Chemistry should prove most valuable in the establishment of standards. It is regrettable that our delegates are so far removed from the European continent that they are rarely able to meet with other members of their committees between the biennial conferences. It is desirable that our federal government provide funds for such attendance upon meetings.

Conclusion

The meetings of the Congress and of the Union were interesting and instructive. Your delegate appreciates

the privilege of having represented the American Ceramic Society and the United States Government at the Congress and the National Academy of Sciences and National Research Council at the Union.

Delegates to X International Congress of Chemistry

C. C. Concannon, A.B., *Chairman of Delegation:* Chief, Chemical Div., Dept. of Commerce, Washington, D. C.
Edward Bartow, Ph.D., D.Sc., Head, Dept. of Chemistry, Univ. of Iowa, Iowa City, Iowa.
Norman Bekkedahl, Ph.D., Associate Chemist, National Bureau of Standards, Dept. of Commerce, Washington D. C.
Marston T. Bogert, Sc.D., LL.D., Professor of Chemistry, Columbia Univ., New York, N. Y.
Henry A. Gardner, D.Sc., President and Director, Institute of Paint and Varnish Research, Washington, D. C.
W. A. Noyes, Ph.D., LL.D., Chem.D., D.Sc., Professor of Chemistry, Univ. of Illinois, Urbana, Ill.
Charles L. Parsons, D.Sc., Dr.Chem., Secretary, American Chemical Society, Washington, D. C.
Alexander Silverman, Sc.D., Head, Dept. of Chemistry, Univ. of Pittsburgh, Pittsburgh, Pa.
W. W. Skinner, D.Sc., Asst. Chief, Bureau of Chemistry and Soils, Dept. of Agriculture, Washington, D. C.
John W. Turrentine, Ph.D., American Potash Institute, Inc., Washington, D. C.
E. R. Weidlein, Sc.D., LL.D., Director, Mellon Institute, Pittsburgh, Pa.

Delegates to XIII Conference International Union of Chemistry

*Edward Bartow, *Chairman;* Head of the Dept. of Chemistry and Chemical Engineering, Univ. of Iowa, Iowa City, Iowa.
Ross A. Baker, Professor of Chemistry, College of the City of New York, New York, N. Y.
Norman P. Bekkedahl, Research Chemist, Rubber Section, National Bureau of Standards, Washington, D. C.
Henry K. Benson, Head of the Depts. of Chemistry and Chemical Engineering, Univ. of Washington, Seattle, Wash.
*Marston T. Bogert, Professor of Organic Chemistry, Columbia Univ., New York, N. Y.
Gustav Egloff, Director of Research, Universal Oil Products Co., Chicago, Ill.
*Colin G. Fink, Professor and Head, Dept. of Chemical Engineering, Columbia Univ., New York, N. Y.
Samuel C. Lind, Professor and Head of the School of Chemistry, Univ. of Minnesota, Minneapolis, Minn.
Thomas Midgley, Jr., Vice-President, Ethyl Gasoline Corp., Worthington, Ohio.
James F. Norris, Professor of Organic Chemistry, Massachusetts Institute of Technology, Cambridge, Mass.
*Charles L. Parsons, Secretary, American Chemical Society, Washington, D. C.
Arthur F. Scott, Professor of Chemistry, Reed College, Portland, Ore.
*Alexander Silverman, Professor and Head of the Dept. of Chemistry, Univ. of Pittsburgh, Pittsburgh, Pa.
*Robert E. Swain, Professor of Chemistry, Stanford Univ., California.
Edward R. Weidlein, Director, Mellon Institute, Pittsburgh, Pa.

* Councillors.

BREAKDOWN OF AMERICAN CERAMIC SOCIETY INVESTMENT ITEM*

STATEMENT OF SECURITIES OWNED AS AT DECEMBER 31, 1937

United States Treasury Bonds	Rate	Interest dates	Maturity	Denomination	Book value
G-10277	3 3/8	June 15 Dec. 15	June 15, 1947	$100.00	$99.87
G-41301	3 3/8	June 15 Dec. 15	June 15, 1947	100.00	99.87
H-102048	4 1/4	Apr. 15 Oct. 16	Oct. 15, 1952	100.00	104.71
E-39325	4 1/4	Apr. 15 Oct. 16	Oct. 15, 1952	100.00	104.71
Total				400.00	409.16
United States Savings Bonds					
L-309765-B			June 1, 1946	50.00	38.04
C-316712-B			"	100.00	76.09
C-316713-B			"	100.00	76.09
D-123767-B			"	500.00	380.48
M-177014-B			"	1000.00	760.95
M-177015-B			"	1000.00	760.95
L-262322-C			June 1, 1947	50.00	37.50
C-231439-C			"	100.00	75.00
D-76930-C			"	500.00	375.00
D-236570-C			Nov. 1, 1947	500.00	375.00
M-401980-C			"	1000.00	750.00
M-72556-C			June 1, 1947	1000.00	750.00
M-62055-C			"	1000.00	750.00
M-482716-C			Jan. 1, 1948	1000.00	750.00
M-482717-C			"	1000.00	750.00
M-482718-C			"	1000.00	750.00
Total				9900.00	7455.10
Grand Total				$10300.00	$7864.26

* See *The Bulletin*, **17** [3] 129 (1938) for complete annual asset and liability statement.

CZECHOSLOVAK CERAMIC SOCIETY

Czechoslovakia is blessed with ceramic raw materials. Clays and kaolins are exported to the whole world and "Sedlecký kaolin" (Zettlitzer kaolin) is an international standard. Czechoslovakian fire clays, feldspars, and quartzites are exported far and wide.

The Czechoslovakian Ceramic Society was founded in 1923 and holds a yearly meeting, which this is year at Moravská Ostrava.

The following committees are working: (1) exploring, (2) terminology, (3) standards, (4) research, (5) education, (6) kiln firing, (7) ceramic history and art, and (8) ceramic museum.

The next meeting of the Czechoslovakian Ceramic Society will take place in May, 1939, in Turčianský Sv. Martin-Slovakia.

—RUDOLF BARTA, *General Secretary, The Czechoslovak Ceramic Society*

Forty-First Annual Meeting American Ceramic Society,
Stevens Hotel, Chicago, Illinois—April 16–22, 1939

EDWARD M. AYERS, PIONEER IN SILICA SAND BUSINESS

Edward M. Ayers was born August 2, 1863. His father, Monroe Ayers, owned and operated steamboats for many years plying between the home port of Zanesville and Pittsburgh and New Orleans; his mother was Louisiana Stull Ayers. His ancestors migrated from England to Massachusetts and in the year 1788 were among the original settlers of Marietta, which pilgrimage is now being celebrated. They went through all of the Indian massacres and other hardships of the period.

Edward M. Ayers was born and educated in the city of Zanesville, Ohio, where he received his high-school education. When he was seventeen years old, he apprenticed in coach painting to establish himself in some trade, which was the custom at that time. On May 17, 1888, Mr. Ayers married Clara Kappes of Zanesville, Ohio, and this year they celebrated their golden wedding anniversary.

In 1883, he opened a stone quarry on his own account, the capital invested amounting to $56.00 of borrowed money. The product from this quarry was sold for building foundations and as stone for a flux.

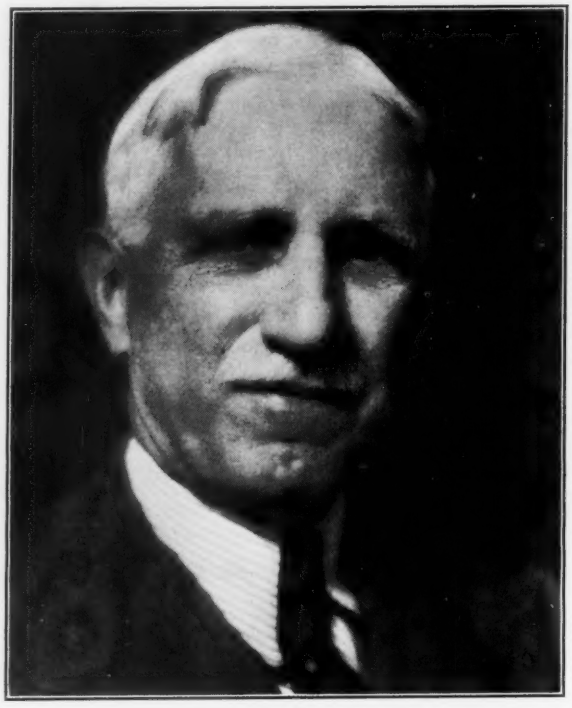
Because the overburden at this stone quarry required removal expense, Mr. Ayers looked about for some market to absorb this otherwise excess material. He found it to be a sand adaptable for iron molding. From this, he developed a demand from foundries throughout the territory east of the Mississippi River. Other deposits were developed which added new and varying grades of sand.

In the year 1900, Mr. Ayers applied a centrifugal machine as the first processing unit in his operations for breaking up the lumps in the sand before shipment. Grinding pans and high-speed cage machines followed, which then originated the blending of the different grades of sand to meet the varying needs of the foundries. In the year 1922, he established standards for certified sands to be sold and delivered to fixed specifications, similar to the practices of the iron, steel, and coke industries. This is standard practice by all shippers of molding sands.

Mr. Ayers is president and general manager of the Ayers Mineral Company, with eight plants operating at and near Blissfield and Zanesville, Ohio. He is also president and general manager of the Central Silica Company, with plant and quarries at Glass Rock, Ohio, and the Millwood Sand Company.

His operations in the silica-sand fields have been continuous since the year 1900. There was nothing novel about this silica-sand operation until the year 1923 when the idea was conceived of refining silica sand to qualify for silica and flint for glass and ceramic use. After three years of research, a process of treatment was discovered which reduced the iron content of his product from 0.06 to 0.015. More effort was required to make this process economically practicable, which, as is known, was accomplished within a short time. The requirement of uniformity of product was met and a control effected which permitted but slight deviation from positive specifications.

In 1892, he added brick and asphalt street paving to his activities, operating from Minneapolis to New Orleans and Houston. The romance of the sand business held such strong appeal to him that in 1900 he decided to confine his entire time to his sand operations.



Edward M. Ayers

His hobbies are travel, golf, and bridge, and more especially the recently founded Art Institute of Zanesville, Ohio, at which place the annual meeting of the Sand Association was held.

His travels have taken him into nearly all countries of the world, much of it having been done by airplane.

Mr. Ayers gives the American Ceramic Society the Corporation Membership support of his company, the Central Silica Company.

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Cadmium Sulphide
Calcspar
Chrome Oxide, Green
Clay, Vallendar
Cobalt Oxide, Black
Cobalt Sulphate
Copper Oxides
Iron Chromate
Iron Oxides
Kryolith
Lead Chromate
Magnesium Carbonate
Manganese Dioxide
Nickel Oxide, Black
Nickel Oxide, Gray
Nickel Sulphate
Potassium Bichromate
Potassium Nitrate
Potassium Permanganate
Powder Blue
Rutile, Powdered
Selenium
Sodium Aluminate
Sodium Antimonate
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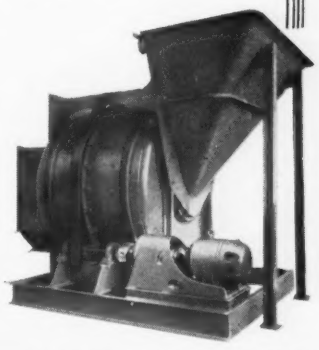

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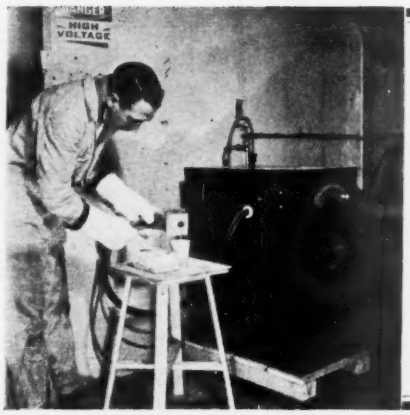

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for chutes, hoppers, dump-car bottoms
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H. C. SPINKS CLAY COMPANY

Miners and Shippers of

BALL, SAGGER AND WAD CLAY

NEWPORT, KY.

Jernigan Mine
Paris, Tennessee
July 21, 1938

Mr. Pete Potter
Comfortable Sanitary Pottery Mfg. Co.
Pottsville, Ohio

Dear Pete:

Well, I have enjoyed writing to you from all parts of the country, and this note from our mines, the starting point of it all.

Spending the Summer down here. We will go home to vote for Spence and Chandler.

Plenty hot here, but we have a lot of good machinery running and are as happy as a bunch of kids with new toys "making Clay while the sun shines." There will be SPINKS CLAY in the sheds for you next Winter, and mined this Summer when it is dry and can be properly selected.

Good luck 'til I see you.

Sincerely,

Dick Carothers

General Manager
H. C. SPINKS CLAY COMPANY

11 Tests

Prove the superior quality of

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SODIUM ANTIMONATE

Every lot of M and T sodium antimonate must pass eleven exacting physical, chemical, and enameling tests before it is shipped from the factory.

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